PB-230 042

POLLUTION OF THE INTERSTATE WATERS OF THE UPPER MISSISSIPPI RIVER. CONFERENCE HELD AT ST. PAUL, MINNESOTA ON FEBRUARY 8, 1964. VOLUME V

Public Health Service
Washington, D.C.

1964

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PB 230 042

CONFERENCE

in the matter of

Pollution of the Interstate Waters of the

UPPER MISSISSIPPI RIVER

VOLUME V

St. Paul, Minnesota

February 1964

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Washington, D.C.

VOLUME V

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MR. STEIN: Let us continue.

MR. SMITH: All right. The next is the City of St. Paul.

Is the City Engineer here?

MR. AVERY: Yes.

STATEMENT OF EUGENE V. AVERY, CHIEF ENGINEER, DEPARTMENT OF PUBLIC WORKS, CITY OF ST. PAUL, MINNESOTA

MR. AVERY: Chairman, distinguished conferees, ladies and gentlemen:

My name is Eugene Avery. I am Chief Engineer, Department of Public Works, City of St. Paul. I am here speaking on behalf of the City Council of St. Paul and to present this statement, which has been approved by them.

The City of St. Paul through the years has been and is now cognizant of the problem of maintaining proper river water qualities in its portion of the Mississippi River. St. Paul has and will continue to cooperate and participate with other interested parties in controlling and reducing water pollution to the greatest extent possible and financially feasible. Much has already been accomplished in St. Paul's direct action and in its action through the Minneapolis-St. Paul Sanitary District. In addition, current work physically underway and plans for the future offer promise of continued progress.

Approximately three decades ago, in recognition of the problem, St. Paul joined with Minneapolis in the formation and the subsequent operation and financing of the Minneapolis-St. Paul Sanitary District and in the expenditure of many millions of dollars for the construction of a central sewage treatment plant and a system of major intercepting sewers. These intercepting sewers, in the St. Paul area, for example, intercepted major sanitary flows at all of the locations where they formerly went directly to the river untreated, and directed this flow instead to the central treatment plant. As a part of these interception works, however, it was necessary to provide for diversion or by-pass of greatly diluted sewage directly to the river during major storm water flows. This was and is still necessary because most of the Twin Cities sewer system developed over approximately 100 years carries combined storm and sanitary flows. Obviously, it was not practical to design the interceptor system and plant to handle the vast volumes of storm water involved. However, St. Paul has, particularly in the last ten years, been separating portions of its system and constructing separate additions to the system wherever possible, physically and financially.

The percentage of the total sewage flow by-passed from the St. Paul sewer system which is above the plant is very minor, as demonstrated by the original design and by actual operational checks. For further information on this subject, the conference is referred to the Minneapolis-St. Paul Sanitary District's statement, Exhibit A, which is the report of their five-year study of sewage disposal problems. Attention is also directed to Mr. Rademacher's report for the Department of Health, Education, and Welfare, presented earlier in this conference. Figures 6 and 7, following Page 41, present coliform counts upstream from St. Paul, and also just above the treatment plant.

The former sewer outlets are inspected twice monthly in a program aimed at keeping direct discharge to the river at a minimum. A copy of the last inspection report, dated January 30, 1964, is attached for the information of this conference. On the basis of these reports, the regulating devices are inspected and adjusted or cleaned if necessary. The complete modernization of these devices and installation of telemetering equipment for better utilization of the interceptors is planned. It is recognized that though the percentage of sewage by-passed from the sewer system is small, it nevertheless is not desirable in the river. The regulator improvements and the separation program are intended to reduce the by-passed flows.

Reproduced from best available copy.

E. V. Avery

Further information about the treatment plant and interceptors is presented in the separate statement of the Minneapolis-St. Paul Sanitary District. Over the years St. Paul citizens and those connected through St. Paul by contract have participated in the expenditure of many millions of dollars for their share in operation and maintenance and the necessary capital addition for Sanitary District facilities over and above the original costs. This includes the current $23 million expansion and improvement of the treatment plant. This is financed, of course, by St. Paul and Minneapolis, who together provide the funds for the Sanitary District capital outlays, as well as operating and maintenance costs.

In its own sewer system activities, St. Paul has and will continue to hold water pollution abatement as one of its major objectives. The construction, separation and improvement of sewers is of a very high order of magnitude in comparison with current expenditures for other city services. Of the approximately five million dollars of expenditures for sewers anticipated in 1964, approximately four and a half million dollars relate directly to construction of separate lines or storm water relief lines. Recently completed at an expenditure of approximately four million dollars was the St. Peter-Rondo Storm Water Relief

Sewer Outfall Tunnel, which is designed to provide a storm water outlet for the ultimate separation program in a densely populated 2,300 acres partly within and westerly of the downtown area. Presently under contract and expected to be completed in May of 1964, is the two million dollar Riverview Storm Water Relief Sewer Outfall Tunnel, which will have a similar function as the St. Peter-Rondo line. Planned for construction contract during 1964 is additional work in the Riverview program totaling $575,000 and the two and a half million dollar first phase of the St. Anthony Park Storm Water Relief Sewer. The latter project, which is an outfall tunnel similar to the St. Peter-Rondo and Riverview projects, is the first phase of a ten million dollar system of main trunks to relieve existing sewers and to provide facilities for a program of ultimate separation of 3,600 acres, much of it heavily populated or used industrially, in the northwest part of the city and contiguous suburban areas. Separation of the sewer system in the downtown clearance and urban renewal areas is planned as a part of that project. The Battle Creek area in the southeast portion of St. Paul and contiguous connected suburbs is being developed with a completely separate system, as is the Riverview Industrial Park of the St. Paul Port Authority.

These examples are only a partial list, but they do demonstrate that St. Paul is taking tangible steps of a very high order of costs, over and above its Sanitary District participation to abate water pollution. Severe financing problems have been and are being encountered, and, of course, are anticipated to continue. St. Paul does recognize, however, the need for the program and intends to continue it just as rapidly and to the extent that resources can be made available consistent with demands for other urban services.

In addition to the previously described construction and planning activities, St. Paul pursuant to recent legislation and in cooperation with Minneapolis, the Sanitary District, the State Department of Health and others is preparing a long-range plan for collection and conveyance to the plant of sewage from the entire east metropolitan area likely to be served through St. Paul by approximately the year 2000. The St. Paul portion of the plan which will also include a finance plan is scheduled for completion by May 1, 1964. Attached for the information of this conference is a copy of the December 17, 1963, Program Report, which describes the study procedure. More information on this study will be contained in the statement of the Minneapolis-St. Paul Sanitary District.

Following the May 1, 1964, report it is planned to continue the work of the special fulltime St. Paul study group in detailing and updating the needed program in the St. Paul system. Objectives of the continuing planning process will be storm water relief and separation where possible, in addition to sanitary sewage capacity. Certain separation projects will be given highest priority because of a need to remove storm water from jointly-used interceptors where the capacity will be needed for sanitary flows from the present and future connected suburbs.

In addition to the planning and construction of physical facilities, St. Paul has been giving increasing attention to regulatory measures consistent with long-range separation objectives and to achieve the best possible use of the existing sewer system. For example, in September of 1963, the building code was revised to require separate plumbing systems and separate connection of clear water flows to storm sewers when such become available. Action pursuant to this ordinance is in progress. Another example is that in areas of limited combined sewer capacity roof drains are disconnected or roof impounding is used.

With respect to industrial pollution, St. Paul has and will continue to cooperate with others in all reasonable ways. Policies on standards requirements and enforcement should probably be set on a State level so that effects can be uniform on appreciable stretches of the river and not confined to one particular municipality or area.

In closing this statement on Mississippi River pollution, it should be noted that streams tributary to the Mississippi contribute pollution also. Control and abatement measures on these streams will have favorable effect on the Mississippi River. Also advisable, we believe, would be more action on a subdivision law regulating sale of lots and subdivision activity on the basis of soil percolation and ground water tests to ensure adequacy of sewage disposal arrangements in outlying areas and prevent overbuilding.

The City of St. Paul is grateful for this opportunity to present its views on this matter. If further questions arise or if additional information is desired, the City Council of St. Paul and its technical staff will be happy to cooperate.

(The inspection report referred to is as follows:)

60amr

[illegible]-13
Revised 5/1/58

1262

MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT

INSPECTION OF FORMER SEWER OUTLETS IN SAINT PAUL

January 30, 19 64

On the above date an inspection of former sewer outlets into the Mississippi River was made by the Sanitary District. The outlet locations and discharge conditions are tabulated below.

Outlet Location	Discharge Condition	Outlet Location	Discharge Condition
Eustis Ave. (Somerville)	NO FLOW	Minnesota	NO FLOW
Otis Ave.	NO FLOW	Cedar	NO FLOW
Marshall Ave.	NO FLOW	Robert	NO FLOW
Portland Ave.	NO FLOW	Eaton	NO FLOW
Princeton Ave.	NO FLOW	Jackson	NO FLOW
Jefferson Ave.	NO FLOW	Sibley	TRICKLE SEWAGE
Randolph W.	NO FLOW	Broadway	NO FLOW
Scheffer	NO FLOW	Mpses	NO FLOW
Otto	NO FLOW	Custer	NO FLOW
Davern	LIGHT FLOW SEWAGE	Arthur	NO FLOW
Otto E.	TRICKLE	Robie	NO FLOW
Randolph E.	NO FLOW	State	NO FLOW
Drake	NO FLOW	Minnetonka	NO FLOW
Smith	NO FLOW	Trout Brook at 4th St.	LIGHT FLOW CLEAN
Sherman	NO FLOW	Trout Brook at River	LIGHT FLOW SEWAGE
Eagle	NO FLOW	Urban	NO FLOW
St. Peter	LIGHT FLOW CLEAN	Belt Line	NO FLOW

Inspected by: S.M.Schwartzfield and P.F.[illegible]

E. V. Avery

PROGRESS REPORT
EAST METROPOLITAN SEWER AND FINANCE STUDY

Prepared in connection with an informational and discussion meeting between representatives of Saint Paul and the outlying affected communities on December 17, 1963

CITY OF SAINT PAUL
DEPARTMENT OF PUBLIC WORKS
BUREAU OF ENGINEERING

Pursuant to legislation passed at the 1963 Session of the Legislature, the cities of St. Paul and Minneapolis and the Minneapolis-St. Paul Sanitary District with the advice and counsel of the Water Pollution Control Commission, the State Board of Health, and affected outlying communities are proceeding with the coordinated preparation of comprehensive long-range sewage collection and treatment plans and financing and service charges pertaining thereto. In accordance with the legislation and as directed generally by a coordinating committee meeting monthly at the Sanitary District offices, the cities of

St. Paul and Minneapolis will prepare collection system plans and related finance and service charge plans for the easterly and westerly portions of the metropolitan area likely to be served through these cities. The two central cities expect to utilize consistent, coordinated criteria in developing their plans which are to be forwarded to the Sanitary District. The Sanitary District will put the information from the central cities together with its plans for sewage treatment and interceptors, other than those through St. Paul and Minneapolis, all together in one comprehensive plan to be submitted to the Water Pollution Control Commission by October 1964.

The particular report contained herein, with the above general background, is concerned only with the St. Paul activities. The meeting at which the report is presented is the second of a series to be held every 60 days for the purpose of informing affected communities of the planning activities. Other information arrangements that have been made include the sending of minutes of the monthly meetings of the coordinating committee and conferences between the special St. Paul engineering study group that has been set up and engineers representing the various areas. Inquiries, suggestions and information from the outlying communities have been solicited by letter and may be made at any time by anyone interested to the study group in Room 38 of the City Hall, Telephone No. Ca. 4-4612, Ext. 439. This information was also transmitted by letter to all the designated engineers on August 7, 1963, and to the representatives present at the first general informational meeting held in October. In addition to the foregoing, a St. Paul Council liaison committee is meeting weekly to study the problem and oversee the study generally.

In making an intermediate report of this type, it must be recognized that the work is in progress and for that reason some of the final answers desired have not yet been determined. However, certain general comments are included hereinafter concerning the engineering and finance studies. A map is attached which depicts our current thinking as to the most likely and best interceptor system. It appears that the recommended system will be somewhat similar, but have a number of differences from the preliminary plans produced previously, these differences being based on more detailed analysis. It should be noted at this point that the study is still proceeding and the plan is still subject to change. It should be noted also that it is understood that pending the construction of some of the major facilities, various localized interim solutions, not necessarily completely compatible with the ultimate system may be desirable and indeed necessary. Certainly, however, the interim solution should be made as compatible as possible with the long-range comprehensive plan.

ENGINEERING STUDY COMMENTS

A. OBJECTIVES - The objective of the study is to prepare the best overall plan for the collection and disposal of sewage from the entire area likely to be served through the City of St. Paul. In addition to planning the sewage collection facilities, a plan for financing these facilities and a formula for apportioning the cost to the various municipalities is to be prepared by the City of St. Paul and submitted to the Minneapolis-St. Paul Sanitary District by May 1, 1964. The twin fundamental objectives of the best and most economical long-range plans for sewage collection and water pollution abatement are kept constantly in mind.

B. STUDY PROCEDURES - In order to accomplish these objectives, the City of St. Paul has formed an engineering study group to prepare the physical plan and a special finance group to prepare a plan for financing and a formula for apportionment of cost. The study is utilizing to the greatest extent possible available information from past studies and from a variety of other sources as indicated in the slide program accompanying this report. In general, the collection system plan of this investigation is concerned only with jointly-used interceptors, and not the local collection system of a given area or community. It is planned that a point of outlet in the jointly-used system would be provided adjacent to or within a given area or community. In general, the procedure is to evolve the best and most economical long-range interceptor plan for the entire east metropolitan area likely to be served through St. Paul by the year 2000. It is recognized that the best overall plan may not be the best for each and every community considered by itself. One of the objectives of the finance study is to consider this problem and propose methods of adjustment. It appears that administratively it would be desirable for one agency rather than several or many agencies to construct and maintain the jointly-used facilities and the study will consider possible ways to accomplish this. The study will also be concerned with combined sewer separation and sewage diversion regulators. Some further study and reports are planned to follow the initial one on May 1, 1964, on an overall interceptor system proposal.

C. ENGINEERING STUDY GROUP - In July, 1963, the St. Paul mayor's office contacted 33 municipalities requesting that each name a policy-making representative and an engineering representative to participate in this sewer plan. As of December 10, 1963, 20 of these 33 communities have named persons as engineering representatives. In a letter prepared August 7, 1963, the Chief Engineer of the St. Paul Public Works Department contacted these 20 engineering representatives and requested as an initial step that nine different items of information be submitted to the engineering study group to assist in preparation of the overall sewer plan. As of December 10, 1963, 11 of the 20 have responded to this request to some extent. These 11 are: Arden Hills, Birchwood, Falcon Heights, Hugo, Mendota Heights, Northdale, East Oakdale, Pine Springs, Shoreview, White Bear Lake and Woodbury Township. In this same letter it was requested that these engineering representatives arrange to meet with the city's study group to discuss the sewer plan as it relates to their specific community and to discuss any engineering studies or reports which may have been made on a community basis. On several occasions, some of these engineering representatives have arranged to discuss certain aspects of the planning; however, it is hoped that all of the engineering representatives will offer their participation more fully in these later stages of the study. We would like to see their suggestions and localized plans made as compatible as possible within the best overall plan, and vice versa.

D. DESIGN PERIOD - The facilities being planned under this study are those required to serve the area through the year 2000.

E. DESIGN CRITERIA - The design criteria being used in this study in general are those used in the 1960 Report on the Expansion of Sewage Works prepared by Toltz, King, Duvall, Anderson & Associates, Inc. These criteria were developed after considerable study and research and are still valid for use at this time. A great number of additional information sources, such as those shown on the slide program accompanying this report, have also been used. The one exception to the design procedure used in the T.K.D.A. Report is that where deep gravity trunk sewers are designed, the probable saturation population would be provided for, rather than the estimated year 2000 population.

F. BOUNDARIES OF SERVICE - It has been necessary to estimate boundaries of service by the year 2000 for areas to be sewered through St. Paul. This estimate is based on topography and watershed boundaries, on future population projections, in some instances on municipal boundaries, on existing sewer connections and contracts, and other related factors. In some locations these boundaries are very indefinite, especially around the north end of Shoreview and in the Mendota Heights area.

G. POPULATION ESTIMATES - The population estimates for the year 2000 as shown in the T.K.D.A. Report have been reviewed and revised upward in some instances. Unfortunately M.P.C. does not have population estimates beyond the year 1980, which are broken down by community and can be used directly for this study. Their overall projections, however, indicate some upward revision of the T.K.D.A. estimates are in order. A further meeting with M.P.C., Minneapolis, and Sanitary District representatives, is scheduled for December 17th, to work further on this problem and to ensure that all participants start from the same basic assumptions.

H. STATUS OF PRELIMINARY INTERCEPTOR SEWER LAYOUT - The engineering study at this time consists of comparing various alternate arrangements and locations of interceptor sewers, pumping stations and force mains. This study of alternates is not complete and, therefore, the arrangement shown on the attached map is not a final answer, but rather a preliminary layout. The map does represent the arrangement most likely to be selected, based on information available at the present time. In some instances sizes of proposed facilities are fairly well established; in other instances sizes have not yet been calculated due to boundary uncertainties or other unresolved problems.

I. COST ESTIMATES AND SCHEDULE OF CONSTRUCTION - When the current study of alternates is resolved, preliminary cost estimates will be prepared for all required facilities. A decade by decade study of interim needs will be undertaken to set up a schedule of construction.

J. STUDY COMPLETION - As previously agreed and specified at coordinating committee meetings, St. Paul expects to complete its report and forward it to the Sanitary District by May 1, 1964. The report outline and form is being refined and given considerable thought in order to ensure maximum utility.

FINANCE STUDY COMMENTS

A Preliminary Statement of Consideration Involved

For the study of construction finance and the service charge or rate "formulas" for charging construction and operating costs, St. Paul has retained an eminent and well qualified consultant. The completion of this study, of course, is necessarily related to and phased somewhat later in time than the engineering study. It is anticipated that this particular report would be completed and forwarded to the Sanitary District by middle or late summer. Obviously, it is premature to attempt to present at this time any final conclusions or recommendations. However, the following comments on general considerations and objectives are offered by the consultant in the interests of information and background.

A. GENERAL - This very preliminary statement is presented at this time to advise the communities concerned of the progress and present status of this aspect of the comprehensive sewage works planning investigation now under way. Until such time as engineering and cost data on the finally selected comprehensive plan and its consideration by officials of the City of St. Paul and affected suburban areas, apportionment of sewage works should now be considered only in its general aspects. It is hoped that this statement, even though it is of necessity preliminary in coverage, will further the cooperative consideration of this problem on a progressive basis by the St. Paul suburban areas.

The aim of a satisfactory apportionment method is to achieve fairness to all concerned. This is a matter of viewpoint and definition. A degree of definition, in general terms, has been provided by the enactment of Chapter 874 Sessions Laws of 1963, which contains the following provision (Section 11 -- Subdivision 6):

"Subd. 6 - All rates and charges shall be reasonable and shall be sufficient to compensate for all costs of devoting the sewage disposal plant, equipment, its collector system, and personnel to the accomplishment of the purpose of the service to be rendered, but shall not include profit. When the sewer system of any municipality or any part thereof is devoted to the use of another municipality, all charges for such use shall be reasonable and shall be sufficient to compensate for all costs of such use, but shall not include profit."

B. SEWAGE WORKS ELEMENTS ON WHICH COSTS ARE TO BE APPORTIONED - A variety of sewage works structures of varying capacities are involved in the question of cost apportionment between the City of St. Paul and tributary suburban areas. Some of these are used by the entire metropolitan connected area (the Pig's Eye Lake sewage treatment plant, for example) and progressing "up-sewer"; others are used by only a fraction of the area, terminating in trunks and branch sewers used only by a single suburban community. Some of the proposed works are designed for a long time in the future (35-40 years) and others for only a period of

15 to 20 years. The existing works of the Minneapolis-St. Paul Sanitary District have been used for 1 to 25 years, but certain portions of the trunk sewers have been in use for more than 80 years. Furthermore, most of the trunk sewers of St. Paul into which suburban areas discharge were designed for multiple service; i.e., storm water runoff and sanitary sewage collection. Their augmentation by separation involves a number of questions associated with apportionment.

1. Existing Works - The existing works are divided into those paid for jointly by Minneapolis and St. Paul and those paid for only by St. Paul. The former includes the treatment plant (with capital additions to date) and the joint interceptor from the plant to the western city limits of St. Paul. (Depending on their location suburban areas use varying lengths of this joint interceptor.

The existing works paid for only by St. Paul include the original intercepting sewers, and the trunk and branch combined sewers within the city which presently do, and in the future could, serve outside areas.

2. Proposed Works - The proposed works can be divided into the following categories:

a. Intercepting sewers used jointly by the city and one or more suburban areas. These can further be subdivided into works within the city and those outside.

b. Intercepting sewers and other sewage works used exclusively by suburban areas (within and outside the city). In addition to intercepting sewers, metering, sampling, and possible chlorinating stations are involved as would be works which are provided for volume and organic load equalization, pretreatment or treatment.

c. Certain trunk sewers required under a separation program by the City of St. Paul to improve river quality and to increase capacity to serve outside areas.

d. The expansion program of the Minneapolis-St. Paul Sanitary District including the treatment plant and possible intercepting sewers and control works.

C. COSTS WHICH MUST BE APPORTIONED - The capital costs, including interest where applicable, and the operation and maintenance costs of the units of the sewage works system described previously, must be apportioned among the various communities using them in whole or in part. To date, data is available on only the existing works, much of the proposed program not having been engineered to the point where reliable cost estimates can be prepared.

D. SOME BASIC CONSIDERATIONS - Lacking costs, capacity, and other detailed data on many of the sewage works which must be apportioned, it is impossible to "spell-out" at this time the many factors which might be incorporated in an apportionment plan or "formula." With the fundamental aim being fairness to all users and beneficiaries of the system, and with a method which is as uncomplicated as is possible consistent with the primary objective, some general observations based on experience elsewhere can be made.

1. On the assumption that the sewage from all suburban areas will be approximately the same concentration (consisting only of domestic and usual commercial sewage -- but free of large volumes of concentrated or deleterious industrial waste) the annual average volume of sewage contributed by a suburban community is a reasonable measure of its use and benefit provided by the sewage treatment plant and can be applied to both capital and operation and maintenance costs. Otherwise pretreatment of the industrial wastes should be required to the

level of domestic sewage or the community assessed a surcharge based on organic and suspended solids load to provide for the extra cost of treatment. To accept strong wastes from one municipality on a basis of apportionment which includes only volume would increase the costs and be unfair to all other areas. In any event no discharge of deleterious or toxic wastes should be permitted.

2. Similarly it would be reasonable to provide for a credit to a municipality which by storage or treatment occasions a lesser use of the sewage works.

3. As a general rule, the costs of intercepting sewers and related facilities used exclusively by one municipality should be paid for by it, either presently or on a deferred basis.

4. The costs of all other sewage works (lateral and branch sewers, metering and sampling stations, etc.) used exclusively by one municipality should be paid for by that municipality.

5. When sewage works are used by more than one municipality it becomes more difficult to make simple generalized statements at this time. Too many overall decisions on engineering and

financial aspects must be made first by the groups charged with the responsibility of comprehensive sewage works planning before a fair method of apportionment for these differing and more complicated situations can be made.

6. Because the principles of apportionment in final result are not exact, and are subject to legal sanctions and restrictions and because departures from great accuracy must be made in order to make the methods finally selected practical and workable, and because areas grow at different rates with respect to sewage service, it seems desirable that the charges against outside areas would, in addition to routine month by month examination, be reviewed periodically (perhaps at three to five years intervals) to ensure that unfairness had not inadvertently developed because of varying growth or for other reasons. Furthermore, it should be pointed out that if one basic method of apportionment, uniform in its application throughout all the suburban areas, is adopted, procedures should ensure exceptions in foreseen special situations, so that unfairness will not result.

7. As stated at the outset, this is a very

preliminary statement of some considerations involved in cost apportionment prepared principally for communication reasons. It must be understood that the city cannot act unilaterally since the entire plan must also be approved by the Minneapolis-St. Paul Sanitary District and the Minnesota Water Pollution Control Commission, and in its final application subject to appeal and review by the courts.

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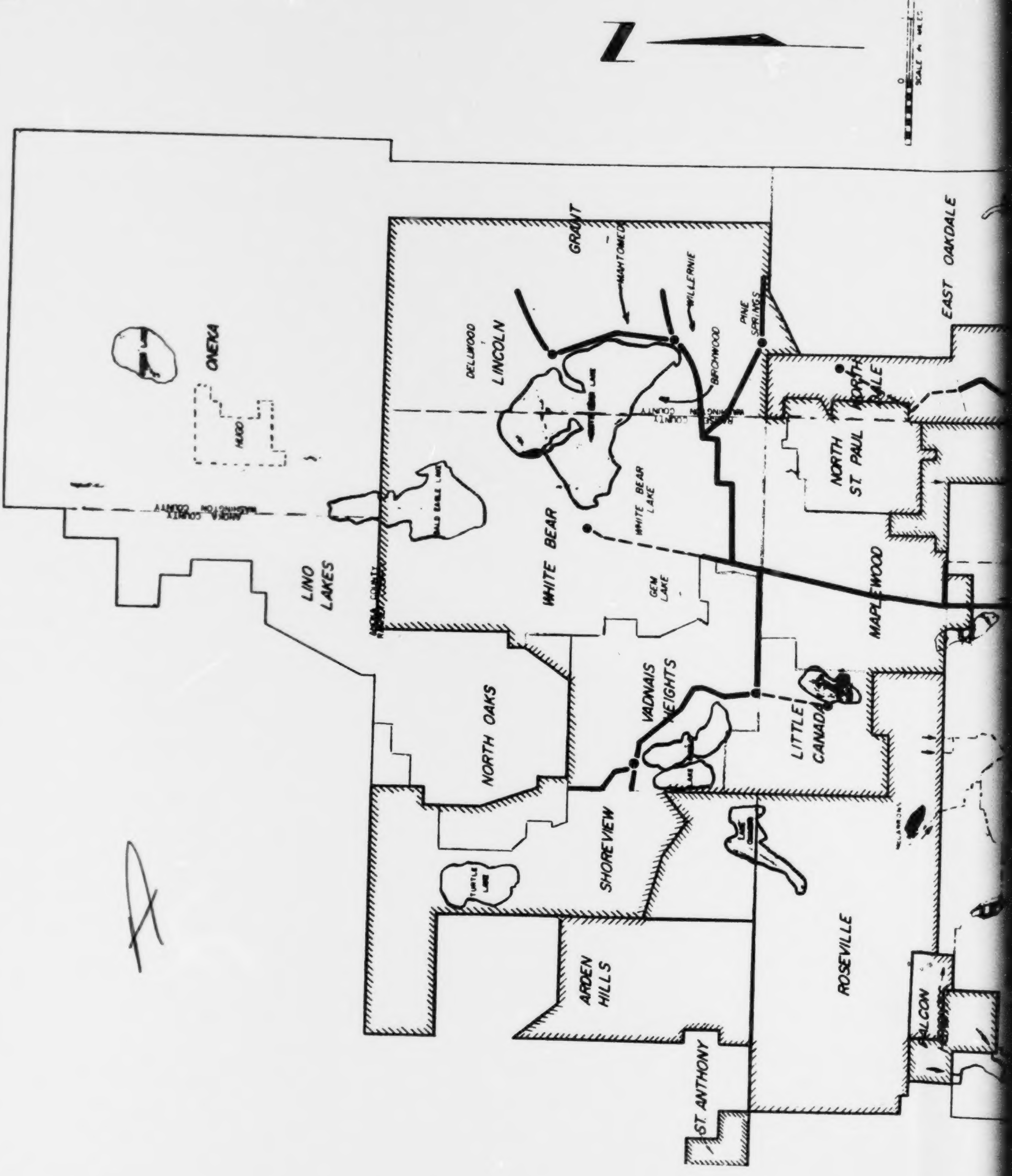
SCALE IN MILES
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WASHINGTON COUNTY
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BALD EAGLE LAKE
WHITE BEAR
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GEM LAKE
DELLWOOD
LINCOLN
GRANT
MAHTOMEDI
WILLERNIE
BIRCHWOOD
PINE SPRINGS
RAMSEY COUNTY
EAST OAKDALE
NORTH ST PAUL
MAPLEWOOD
LITTLE CANADA
VADNAIS HEIGHTS
NORTH OAKS
SHOREVIEW
TURTLE LAKE
ARDEN HILLS
ST. ANTHONY
ROSEVILLE
FALCON HEIGHTS

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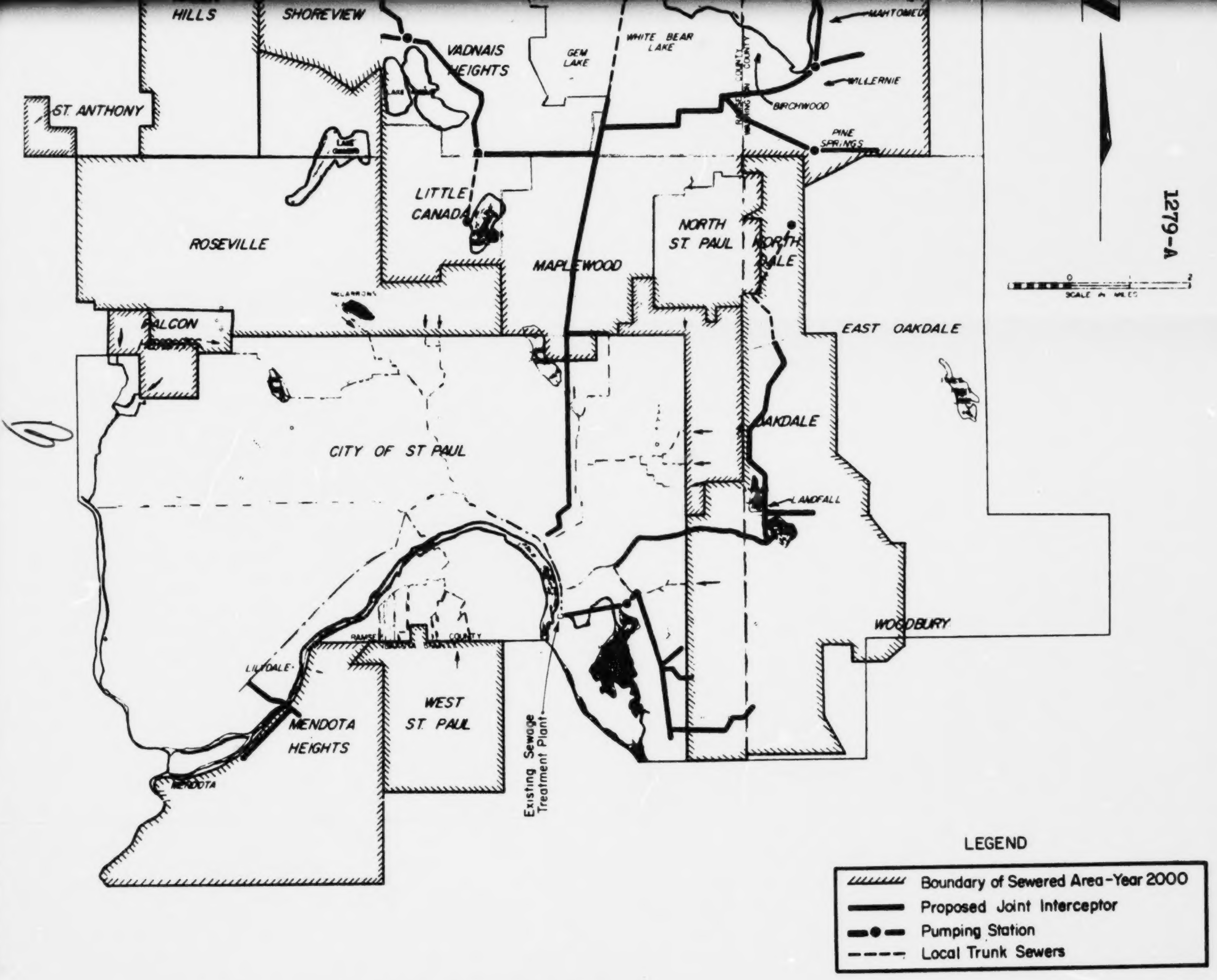
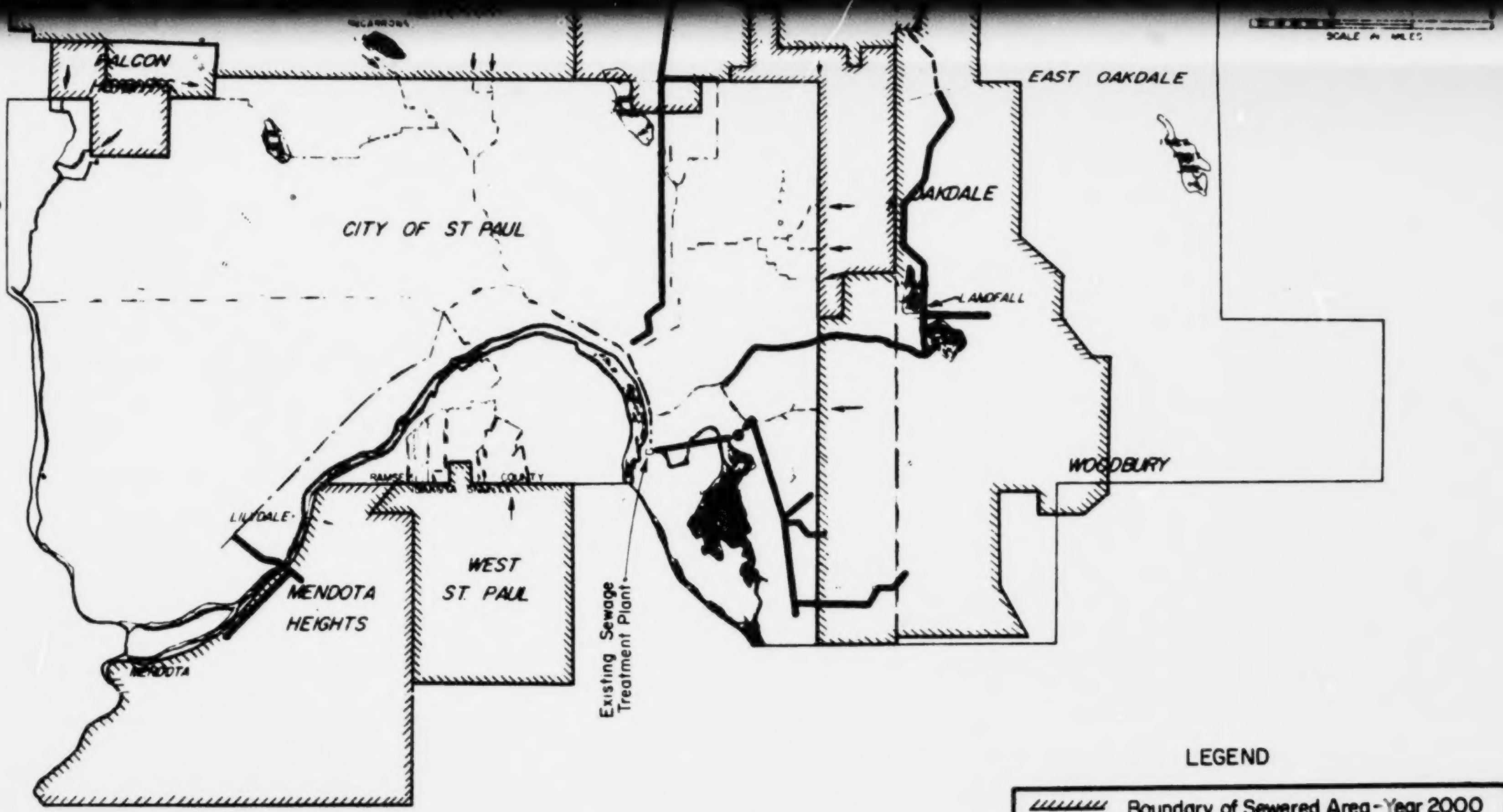


SANITARY INTERCEPTOR SEWERS
PRELIMINARY
SUBJECT TO CHANGE

1280-A



LEGEND

- ▨ Boundary of Sewered Area - Year 2000
- ━ Proposed Joint Interceptor
- ━●━ Pumping Station
- - - - Local Trunk Sewers

SANITARY INTERCEPTOR SEWERS
PRELIMINARY

SUBJECT TO CHANGE
DECEMBER 17, 1963

CITY OF ST. PAUL
DEPARTMENT OF PUBLIC WORKS
METROPOLITAN COMPREHENSIVE
SANITARY SEWER PLANNING OFFICE
ROOM 38, CITY HALL & COURT HOUSE
ST PAUL, MINN.
224-4612 Ext. 439
OCT. 22, 1963

MR. STEIN: Thank you very much for a very good statement.

Are there any comments or questions?

DR. HARGRAVES: Do you have copies of your report?

MR. AVERY: The reporter has a copy.

MR. STEIN: I just have one short question. How long do you think it will be before you complete your separation program if you go into this?

MR. AVERY: The separation program in St. Paul is an extremely difficult and costly one, if you think of it in terms of complete separation, because complete separation, of course, involves very substantial and expansive construction almost in every street in the city.

It involves not only construction within the streets, but within the buildings, so it is likely to be many years before complete separation would be achieved. However, it is our hope that we can achieve separation in substantial areas between now and perhaps ten years from now, and also achieve the complete reconstruction and modernizing of the regulating devices, which we believe offers more opportunity for progress per dollar spent.

MR. STEIN: Thank you very much.

MR. SMITH: The next will be a statement, I believe, from the St. Paul Water Department.

STATEMENT OF CLIFFORD W. HAMBLIN, GENERAL MANAGER, ST. PAUL WATER DEPARTMENT, ST. PAUL, MINNESOTA

MR. HAMBLIN: Mr. Chairman, conferees, ladies and gentlemen:

My name is Clifford Hamblin, General Manager for the St. Paul Water Department.

I am going to read a statement for the Board of Water Commissioners of the City of St. Paul.

The Board of Water Commissioners of the City of St. Paul, whose responsibility it is to supply a potable water to the population of St. Paul and all adjacent suburbs thereto, are most vitally concerned with the sanitary qualities of the Mississippi River. The Mississippi River has been relied upon by St. Paul for its source of water supply since 1925, and with the future anticipated increase in population and use demands, will be more dependent upon the river to supply the St. Paul area population. The Board's intake is located at Fridley, Minnesota, and to date no detrimental pollution has been encountered; however, in the future, all possible means should be taken to control pollution in the reaches of the river above the St. Paul intake to safeguard against any sanitary hazard that could be harmful in providing a potable water to the St. Paul area population.

Thank you.

MR. STEIN: Thank you very much, sir.

Are there any comments or questions?

(No response.)

MR. STEIN: If not, thank you very much for your statement.

MR. SMITH: I would like next to go to the Minnesota River, and the first municipality in the area with which we are concerned is North Mankato.

Is there anyone from North Mankato present?

(No response.)

MR. SMITH: If not, I would like to ask Mr. Thimsen again to read the paragraph indicating the treatment provided.

FURTHER STATEMENT OF DONALD J. THIMSEN, MINNESOTA DEPARTMENT OF HEALTH, SECTION ON WATER POLLUTION

MR. THIMSEN: North Mankato:

Plans for a forcemain to carry raw sewage from North Mankato across the Minnesota River to an existing interceptor sewer in Mankato were approved on August 7, 1963. A contract has been made for treatment of the North Mankato sewage in the Mankato sewage treatment plant. The forcemain is now under construction and is expected to be in operation early in the spring.

MR. STEIN: All right, Mr. Thimsen. Will you stay, Mr. Thimsen? There is a whole series of them, one right after another. I think we will proceed, unless there are any questions.

MR. SMITH: The next one would be Mankato. Is there a representative from Mankato present?

(No response.)

MR. THIMSEN: Mankato:

The Mankato plant was constructed in 1961 and is a primary plant consisting of a control building, two primary settling tanks, a chlorination contact tank, two sludge digesters, a sludge drying bed, and a sludge lagoon. The plant is designed for a sewage and waste flow of 5.82 mgd with a 5-day BOD of 250 mg/1. Part of the sewer system is combined sanitary and storm.

MR. SMITH: St. Peter?

MR. THIMSEN: St. Peter:

The St. Peter sewage works were constructed in 1963, and consist of a lift station and forcemain, two primary and one secondary raw sewage stabilization ponds. The primary ponds have a total surface area of about 148 acres, and the secondary pond has a liquid surface of about 47 acres. The ponds are designed to treat a sewage and waste flow of about 1.1 mgd with a 5-day BOD of about 270 mg/1. The storage time at the design flow of 1.1 mgd is about 270 days, based upon a depth of 4 feet in the primary ponds and 5 feet in the secondary pond. These facilities also serve the State Hospital at St. Peter.

MR. SMITH: LeSueur?

MR. THIMSEN: LeSueur:

A lift station and forcemain and two primary and one secondary raw sewage stabilization ponds were constructed in 1963. The ponds are designed to treat a sewage and waste flow of about 0.397 mgd with a 5-day BOD of about 345 mg/1. The primary ponds have a total surface area of about 60 acres. The secondary pond has a surface area of about 21 acres. The storage time in the ponds at the design flow is about 285 days, based on a storage depth of four feet in the primary ponds and five feet in the secondary pond.

MR. SMITH: The village of Henderson?

MR. THIMSEN: Henderson:

This is the only sewered municipality located on the Minnesota River which does not provide treatment, or has not yet made arrangements for treatment, of the sewage before discharging it to the river. On August 5, 1963, the Commission informed the village that planning for the orderly development of adequate facilities for treatment of the sewage and industrial waste for which they are responsible must proceed without delay. The village thereupon employed a consulting engineer to conduct an engineering study and prepare a preliminary report and so advised this Commission on November 21, 1963.

MR. SMITH: Belle Plaine?

MR. THIMSEN: Belle Plaine:

The borough sewage works were constructed in 1963 and consist of one primary and one secondary raw sewage stabilization pond. The ponds are designed to treat a sewage and waste flow of 0.20 mgd with a 5-day BOD of about 390 mg/l. The primary pond has a surface area of about 33 acres and the secondary pond has about 14 acres. A storage period of about 250 days is provided at the design flow.

MR. SMITH: Chaska?

MR. THIMSEN: Chaska:

The Chaska sewage treatment plant was constructed in 1963 and is a secondary plant consisting of bar screens and comminutor, grit removal equipment, a contact aeration tank, a reaeration tank, an aerobic sludge digestion tank, settling tanks, and chlorine contact tanks. It is designed to treat a sewage and waste flow of 0.75 mgd with a 5-day BOD of about 200 mg/1. Since there are no other sewage treatment plants of this type in operation in Minnesota, the plans were approved with the reservation that modifications to the plant would be required if performance is not satisfactory.

MR. SMITH: Shakopee?

MR. THIMSEN: Shakopee:

This plant was constructed in 1961. It is a primary plant and includes a control building, a dual primary settling tank, a dual chlorination tank, two sludge digestion tanks, and a sludge drying bed. The plant is designed to treat 0.90 mgd of sewage and waste at a 5-day BOD of about 300 mg/1 to produce an effluent of about 200 mg/1. Provision is made in the design of the interceptor sewer for the possible future discharge of the Rahr Malting Company wastes to the municipal plant for treatment when secondary units are constructed.

MR. SMITH: Savage?

MR. THIMSEN: Savage:

A new sewage treatment plant was constructed in 1963 and replaced a plant which was constructed in 1939. The new plant consists of a control building, a primary settling tank, a high-rate trickling filter, a secondary settling tank, a heated sludge digester, and a sludge drying bed. Provision is also made for chlorination of the plant effluent. The plant is designed to treat 0.39 mgd of sewage and waste with a 5-day BOD of about 210 mg/l to produce an effluent of about 40 mg/l. Final disposal of the plant effluent is to a creek which joins the Minnesota River.

MR. SMITH: Is there anyone here from Burnsville Township?

(No response.)

MR. SMITH: I have a statement, Mr. Chairman, which was submitted.

MR. STEIN: Would you want to read that? It looks rather short.

MR. SMITH: I believe it should be read.

MR. STEIN: Yes.

MR. SMITH: It is addressed to the Commission and reads as follows:

"We have received notice of the hearing to be held February 7, 1964 on pollution of the Mississippi River from the Rum River through Lake Pepin including major tributaries. The following statement is provided in accordance with that notice.

"Burnsville Township has recently completed the first portion of a trunk sewer system and sewage treatment plant which will ultimately serve an estimated 80,000 people in this township. The sewage treatment plan in present use is designed to handle 500,000 gallons per day or approximately 1600 homes. It is a modified activated sludge plant providing primary and secondary treatment with chlorination of the effluent. Discharge is into a small creek which flows into Black Dog Lake and thence into the Minnesota River. The plant is designed for expansion with additional increments expected to be built as the demand grows. This plant is considered to be a permanent type interim plant.

"It is respectfully requested that the present and future needs of this community for use of the Minnesota River for disposal of sewage plant effluent be considered consistent with reasonable standards of pollution control downstream. This township has in the past and will continue to cooperate with the Water Pollution Control Commission in maintaining proper stream standards."

This is dated February 5, 1964.

MR. STEIN: Thank you, Mr. Smith. I hope these permanent-type interim plants aren't like our temporary buildings in Washington that have been there since World War I.

MR. SMITH: I also have a statement from the Eagan Township Board. Is there a representative here from that township?

(No response.)

MR. SMITH: If I may, Mr. Chairman, I will read that.

MR. STEIN: If you would.

MR. SMITH: This again is addressed to the Water Pollution Control Commission, dated February 4, 1964, and reads:

"Your notice has been received of the conference of Feb. 7, 1964 on pollution of the Mississippi River from the Rum River downstream through Lake Pepin, including major tributaries.

"We are providing the following statement in accordance with your notice.

"At the present time, one area of Eagan Township having approximately 600 homes is being served by a small franchise sewage treatment plant which discharges its effluent into the Minnesota River. This is an activated sludge plant providing primary and secondary treatment with chlorination of the final effluent.

"It is expected that this plant must be expanded as the demand grows within the area included in the franchise. Additional plants of this or similar type are expected to be required to serve the other parts of the township and to have ultimate disposal in the Minnesota River. Interim plants of this nature will be necessary for many years unless and until a sewage interceptor system is installed to serve this general area. Such use is essential if ground water pollution is to be avoided.

"Eagan Township respectfully requests that the requirements of this area for the use of the Minnesota River for sewage plant effluent disposal be favorably considered. It is expected that reasonable standards of pollution control will be "established consistent with our use requirements."

MR. STEIN: Thank you.

MR. SMITH: I also have a statement addressed to the United States Public Health Service with respect to the Cedar Grove Utilities Company, which operates the sewage treatment works referred to in the Eagan Township letter. I have a number of copies of this, Mr. Chairman.

MR. STEIN: You want to have this put into the record as if read, do you?

MR. SMITH: Yes, certainly.

> "Please be advised that our firm represents Cedar Grove Utilities Company, a Minnesota Corporation, and Suburban Utilities, Inc., a Minnesota Corporation, both of whom are currently operating privately owned sewage disposal plants, one situated in Eagan Township, Dakota County, Minnesota, and the other situated in Inver Grove Township, Dakota County, Minnesota.
>
> "Cedar Grove Utilities Company plant presently serves 800 homes and can be expanded to service additional homes as the demand arises. Treatment at this plant is presently averaging 90 to 95% B.O.D. removal and the effluent is being chlorinated. Following the chlorination of the effluent, it is drained into a creek which flows into the Minnesota

"River. The high degree of efficiency of this plant results in no pollution of the waterways under consideration by your body in our opinion.

"Suburban Utilities, Inc., presently operates facilities serving 150 homes. These facilities are so designed that they can be expanded to service additional homes as needed. This plant also operates at a 90 to 95% B.O.D. removal efficiency, and again it is our position that the chlorinated effluent discharged into a natural drainage course has no effect on the pollution of the river. In fact, under the present operation, the effluent discharge is absorbed in the sandy soil prior to reaching the river. This plant is to be taken over by the Township of Inver Grove, probably within one year.

"It is our intention that by this letter our interests may be noted in the record of the proceedings; that we will be informed of any further hearings and request that correspondence in these matters be addressed to Cedar Grove Utilities Company, 3216 South Grove Lane, South St. Paul, Minnesota.

"In closing, we wish to note our opinion that "the Minnesota Department of Health has excellent facilities for the supervision of installations such as we have constructed. Their cooperation and assistance is a vital factor in the creation of the efficient operations we presently conduct."

MR. STEIN: Thank you.

MR. SMITH: Having gone down the Minnesota River, we again would start at the confluence of the two rivers and continue down the Mississippi River.

Next I would like to call on the Minneapolis-St. Paul Sanitary District.

STATEMENT OF KERWIN L. MICK, CHIEF ENGINEER AND SUPERINTENDENT, MINNEAPOLIS-ST. PAUL SANITARY DISTRICT

MR. MICK: Mr. Chairman, distinguished conferees, ladies and gentlemen:

The statement that I have, although we are probably the biggest single polluter in this area, is one of the shortest, except for the exhibits. I have six exhibits, five of which are enclosed in the yellow envelope which each of the conferees has, and the sixth, really Exhibit A, the first one, is in the package at the end of the table and consists of the five-year study of the sewer disposal problem in the metropolitan area that was mentioned by other speakers today.

The other exhibits, Exhibit B through Exhibit F, are contained in the envelope, and I would request that they be entered into the record; but Exhibit A is too voluminous for that and should be entered only as an exhibit to be attached. We would like all of the exhibits, except Exhibit A, to be part of the record.

MR. STEIN: Let me look at this exhibit, if you don't mind, for a moment.

Without objection, they will be entered in the record.

MR. MICK: Proceeding with the statement itself, a notice of this conference dated January 7, 1964, was received from Robert N. Barr, M.D., Secretary of the Minnesota State Water Pollution Control Commission. The notice states, in part: "... those municipalities ... contributing directly to pollution ... are asked to tell what they have done and what they propose to do toward abatement of such pollution." This statement is intended to summarize the work of the Minneapolis-St. Paul Sanitary District in this regard.

The District submits the following summary points of information:

(1) Pursuant to requests from the Minnesota State Department of Health, the Cities of Minneapolis and St. Paul pioneered by placing in operation in 1938 the first sewage treatment plant serving a metropolitan area anywhere on the main stem of the Mississippi, the Missouri, and the Ohio Rivers. This primary treatment plant operated for nearly twenty years with little or no complaints of unfavorable river conditions.

(2) The population explosion of the 1950's

and the fact that the treatment plant was reaching its design loading led the Board of Trustees of this Sanitary District to make a comprehensive study (1956-61) of the sewage disposal problem of the metropolitan area, with recommendations for several possible solutions. The report on this study was published in four volumes, copies of which are submitted with this statement (Exhibit A).

(3) Although the 1961 session of the State legislature failed to pass enabling legislation for the creation of a metropolitan-wide sanitary district because of insufficient agreement between the cities and the suburbs, the Board of Trustees of this Sanitary District waited no longer, but without prodding or Federal assistance proceeded at once (June 1961) with the design of an expansion of the present plant to provide secondary treatment. This expansion is now under construction and is expected to cost approximately $23,000,000.

(4) The current plant expansion program is designed to serve the central cities and the 24 suburbs connected at the time of design (April 1962), providing for their estimated growth to the year 1980 with a design removal of 75% of the biochemical oxygen demand and with disinfection of the effluent

during the summer season. The plant is designed to be readily expandable to serve additional area and to provide still higher degrees of treatment when proved necessary.

It was mentioned this morning by one of the other speakers that they have now under contract with the city not 24 suburbs, but 37 plus six agencies, or a total of 43. That means if we expand the plant, when it is done it will not last until the year 1980 for the 24 suburbs, but will have to be expanded again sometime prior to that.

(5) Under the provisions of the Ashbach Bill passed in the 1963 session of the State legislature (Chapter No. 882), this Sanitary District, together with the Cities of Minneapolis and St. Paul, has been proceeding since June 1963, with the preparation of a comprehensive plan for sewage collection and disposal for the entire area likely to be served by the sewage treatment facilities of this District. The completion date for this plan is currently scheduled for October 1, 1964. It is to be submitted to the State Water Pollution Control Commission.

This Sanitary District believes that the record outlined above constitutes reasonable and adequate progress with the solution of that portion of the sewage disposal problem for which it is responsible.

The six exhibits which we are submitting with this statement consist of the five-year study report, which is Exhibit A.

Exhibit B is a subsequent report entitled "Staff-Recommended Solution to the Metropolitan Sewage Disposal Problem, dated January 22, 1962.

Exhibit C is a District statement made at the hearings referred to by previous speakers, hearings by the Minnesota State Board of Health and Water Pollution Control Commission, relative to proposed classification and adoption of water quality standards for the Mississippi River in the Minneapolis-St. Paul area.

Exhibit D is a statement presented by this District on June 27, 1962, relative to operation of the head-water reservoirs. It was presented at a hearing held by the United States Army District Engineer in Grand Rapids, Minnesota.

Exhibit E is a statement dated July 19, 1962, again presented at the hearing relative to the classification of the river in this area.

Exhibit F is a summary statement presented at that hearing.

(The Minneapolis-St. Paul Sanitary District Exhibits B through F are as follows:

EXHIBIT B

MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT

REPORT TO THE BOARD OF TRUSTEES
ON
STAFF-RECOMMENDED SOLUTION TO THE METROPOLITAN SEWAGE DISPOSAL PROBLEM

KERWIN L. MICK
CHIEF ENGINEER AND SUPERINTENDENT
January 22, 1962

KERWIN L. MICK PHONE: PR. 1-8845 D. D. WOZNIAK
CHIEF ENGINEER AND SUPERINTENDENT ATTORNEY

MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT
2400 CHILDS ROAD
SAINT PAUL 6, MINNESOTA

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LOUIS J. BARTSCHER,
Executive Secretary
ADDRESS ALL COMMUNICATIONS
TO THE SECRETARY UNLESS
OTHERWISE REQUESTED

To the Board of Trustees Presented January 22, 1962

Gentlemen: Re: STAFF-RECOMMENDED SOLUTION
TO THE METROPOLITAN SEWAGE
DISPOSAL PROBLEM

Report Requested.

Preparation of this report was requested by the Board on November 27, 1961.

Scope of Report.

The purpose of this report is to present specific staff recommendations for the solution of the metropolitan sewage disposal problem. The detailed reports (Volumes I-IV) of the programed five-year study just completed by this sanitary district contain a number of recommended alternative solutions to the problem with respect to types of organizational structure, boundaries, sewage collection and treatment projects, apportionment of costs, and repayment of equities in the present system. These alternatives have been discussed extensively by different interested groups and legislative committees during the past year or more but no general agreement has been reached. The Board of Trustees of this sanitary district has not yet taken a position on these alternatives, but to facilitate consideration of the problem it has now requested specific staff recommendations for an adequate and equitable solution.

As most of the alternatives were discussed extensively in the reports of the five-year study, such discussion will be held to a minimum in this report and some references to the preceding reports will be made.

Recommendations.

1. Introduction. Because of inter-relationships, specific recommendations as to organizational structure, boundaries, sewage collection and treatment projects, and apportionment of costs cannot be made separately or independently of each other. Whatever is recommended for one of these facets of the problem will influence consideration of most of the remainder. This results in a considerable number of possible combinations. From a staff viewpoint, however, a consideration of a really adequate solution to the problem reduces the usable combinations very markedly.

The principal objectives which must be achieved in providing an adequate solution to the sewage disposal problem of the metropolitan area may be stated as follows:

a. Protection of water supplies and reduction of health hazards to a minimum.

b. Elimination of nuisance conditions resulting from inadequate sewage disposal.

c. Restoration and preservation, to the greatest extent practicable, of the recreational use of watercourses.

In order to achieve these objectives, it is necessary to consider the sewage disposal problem not only as it exists at the present time, but in the long-range future with the population of the metropolitan area expected to double within the next forty years, to approximately 3,000,000 people.

2. General Recommendation. In order to adequately achieve the stated objectives in solving the sewage disposal problem, the staff recommends that the sewage be collected from the area of major concentration of population (90% or more) in the metropolitan area in an articulated sewer system tributary to a single treatment plant located below the major populated area. It is of interest to recall that more than thirty years ago the Metropolitan Drainage Commission arrived at substantially the same conclusion (Annual Report 1928) after studying a number of alternative solutions. This recommendation does not necessarily apply to the Lake Minnetonka and the Southeast Regions (Figure 2-20, Volume III). These regions could each be served by one or more separate sewer systems and treatment plants as contemplated in the reports of the five-year study, without being inconsistent with the above general recommendation.

3. Specific Recommendations. With the foregoing general recommendation as a basis, the following more specific recommendations are made as to organizational

structure, boundaries, sewage collection and treatment projects, and apportionment of costs.

A. Organizational Structure. In order to achieve the stated objectives and general recommendation, the staff is of the opinion that it will be necessary to utilize one of the following two types of organizational structures:

(1) The present Minneapolis-Saint Paul Sanitary District, with expanded provisions for contracting with and construction for outside areas; for review and possible revision of existing contracts including rate structures, upon appeal by any affected municipality; for long-range planning and construction in accordance with a master plan; and for possible representation on the Board of Trustees from the outside area (possibly two additional board members, appointed by the Governor or the Mayors of the central cities as is done in Detroit).

(2) A new metropolitan sanitary district, with expanded boundaries and authority, with representation on the Board of Trustees from the entire area, with provisions for repayment of equities in existing jointly used sewage works, and with an equitable method of apportioning costs for the construction and operation of all jointly used collecting sewers and treatment works.

As to a choice between an enlarged metropolitan sanitary district and continuation of the contract system, the staff believes that either one could be made to function satisfactorily, with proper enabling legislation, and a choice should come after consideration of the remaining facets of the problem. Other metropolitan areas using one or the other of these two organizational structures are listed in Table 1 attached.

Regional sanitary districts. Another type of organizational structure has been considered, involving a continuation of the present sanitary district and the formation of a number of other regional, independent sanitary districts (of which the existing North Suburban Sanitary Sewer District would be one), which might or might not contract with the present district through the central cities. Such a system is not recommended by the staff because of lack of assurance that the objectives and general recommendation as stated in this report would be achieved. Unless the regional projects conformed to the above general recommendation for essentially complete downriver discharge of treatment plant effluents, they could result in added pollution in the pool above St. Anthony Falls, from which the water supply of the central cities and some connected suburbs is taken, added pollution in the Minnesota River just above the proposed new Ft. Snelling state park and above St. Paul, and added pollution in the lakes in the White Bear vicinity draining toward the water supplies of the central cities (Figure 4-3, Volume III).

For these reasons the staff does not favor the formation of a number of independent regional sanitary districts in the area of major population concentration, with the possible exception of the Lake Minnetonka and the Southeast Regions and except as might prove advantageous to facilitate the construction and operation of regional sewage collecting systems connecting to the main interceptors provided under either organizational structure (1) or (2) above.

B. Boundaries.

Present Boundaries. If the method of contractual agreements between the suburbs and the central cities and this sanitary district becomes the organizational structure of choice, then the present district boundaries could remain unchanged. This is one of the advantages of the contract system; there is no boundary problem, except as to decisions on sewer capacities.

Ultimate Limits of Service. If it is decided to create an enlarged metropolitan sanitary district, the question of where to set the boundaries becomes more complicated. In the staff's opinion, the maximum area which should be considered for inclusion in the district should be that represented within the "Ultimate Limits of Future Sanitary District" as shown on Figure 2-20 in Volume Three and Figure 1 of this report. Compared with the boundaries of the present sanitary district which are the city limits of the central cities, enclosing approximately 115 square miles, the "Ultimate Limits" encompass 1,170 square miles, or ten times the present district. These are considered to represent the limits of a single articulated sewer system which could serve, with one treatment plant (except for the Southeast Region), over 90% of the present and future population in the metropolitan area.

Parts of the "ultimate limits" area, however, would not become sufficiently populated to support a sewer system even by the year 2000. It is not usually financially feasible to provide sewers in an area having less than 125 dwelling units per quarter square mile or about 3 persons per acre. Although complete coverage of the area with sewerage systems is not expected within the next forty years, all major sewage works undertaken in the area should be part of a unified master plan.

Intermediate Boundaries. The initial boundaries of an enlarged district could be smaller than the "ultimate limits," with provision for further expansion. This would simplify the organizational, administrative, and financing problems somewhat, but would make it more difficult to follow a unified master plan for the area and to construct adequately sized sewers for the long-range future (40 years or more).

The following considerations facilitate the selection of "intermediate boundaries." The 114 square mile Lake Minnetonka Region might be omitted on the basis of economic considerations and sparse population, estimated at 1.7 persons per acre of service in 1980 and 1.9 in the year 2000 (pp. 2-29 and 2-30, Vol. III), which is rather low to finance sewage works except in scattered areas of concentration. Individual community plants in such areas must discharge into the lake as do the existing plants at Wayzata and Excelsior. The nutrients discharged into the lake may eventually cause nuisance algae blooms, although it may be possible to avoid this by the use of effluent lagoons, where algae growths in a confined area would consume the nutrients. If it is considered necessary to keep effluents out of the lake, however, cost estimates (p. 2-44, Vol. III) favor a separate regional system with a plant on the Minnesota River above Shakopee near Chaska, approximately 24 miles above Mendota.

The 175 square mile Southeast Region might also be excluded from the enlarged sanitary district on the basis that it lies downriver from the heavy concentration of population and requires one or more separate sewer systems and treatment plants as indicated in Volume III. It would not be part of the single articulated sewer system and treatment plant that is possible for the major part of the metropolitan area. It already has three municipal treatment plants and several industrial waste treatment works. The Southeast Region will place a considerable load on the river due to industrial wastes, in addition to that from the relatively smaller domestic population. The principal reason for including it in an enlarged metropolitan sanitary district would be to exercise some coordination and control over the performance of treatment works in that region on the basis that they, along with the Minneapolis-St. Paul plant, share in using the assimilative capacity of the river in the Hastings Pool. Coordination and control should be exercised by some agency. At present this control lies only in the State Water Pollution Control Commission which is not presently adequately staffed or funded to perform such coordination on a day-to-day basis.

The boundaries of an enlarged sanitary district might be further reduced initially, as compared with the "ultimate limits," by omitting some of the fringe areas which would probably not receive sewer service for twenty years or more. An inspection of the estimated areas of service on Fig. 2-21, Vol. III, indicates that the five townships of Dayton, Eagle Creek, Oneka, Grant, and possibly East Oakdale, a total area of approximately 127 square miles, might be excluded from the initial district on this basis.

Intermediate boundaries accordingly might be based on the "ultimate limits" of 1,170 square miles less the Lake Minnetonka Region, the Southeast Region, and the five outer fringe townships, leaving an initial district of approximately 750 square miles.

A map showing the present Minneapolis-Saint Paul Sanitary District, the 24 suburbs presently served under contract agreements, and possible future boundaries of an enlarged district is shown on Figure No. 1.

C. Sewage Collection and Treatment Project. The staff recommends Project "A," described in Volume III, as the best project to accomplish the long-range objectives set forth in this report and permit the greatest degree of beneficial use of the water resources of the metropolitan area. This is the project that would collect the sewage from the area of major concentration of population (90% or more) in the metropolitan area in a single articulated sewer system with one treatment plant in the Pigs Eye Lake area.

This project could be accomplished at a reasonable cost either under a modification of the present contracting system or under an enlarged, metropolitan sanitary district.

D. Apportionment of Costs.

Whether the organizational structure be an enlarged district or an extension of the present contract system, it is contemplated that the charges apportioned to a given municipality would, as at present, be billed as a lump sum, broken down into fixed charges and operating costs, which could then be procured by the municipality in any manner it sees fit, e.g., by sewage service charge, connection charge, ad valorem tax, area charge, special assessment, etc.

Apportionment Under a Contract System. Under the contract system, the total annual charges apportioned to a given municipality would be in accordance with the terms of the contract agreement between that municipality and the central city or the sanitary district. Payment of equities for use of existing sewage works would be included in the terms of the contract, as at present. There appears to be a need for a review of existing contracts, particularly as to uniformity and as to rate structures, i.e., whether they are adequate and equitable for present and future conditions. There might well be some procedure whereby a municipality which becomes dissatisfied with the terms of a contract agreement with one of the central cities could appeal to another body for a review and arbitration of the points of disagreement. This appeal could be to the district court or even to the Board of Trustees of the sanitary district, particularly if its membership included representation from the suburban areas as suggested above under "Organizational Structure." Wisconsin has a State agency, the Wisconsin Public Service Commission, to which sewage works rate structures can be appealed. Minnesota has only the Railroad and Warehouse Commission, which at present is not set up to hear appeals on sewage rate structures.

Apportionment Under An Enlarged Metropolitan Sanitary District. Under an enlarged metropolitan sanitary district, the apportionment of costs becomes more complicated. It is necessary to work out in advance and include in the enabling legislation a cost apportionment formula applicable generally over a large area, together with a method of repayment of present user's equities in existing sewage works which are or will be used jointly with others, in proportion to such use. This problem was considered in considerable detail in Part Three of Volume Two, wherein 18 methods of cost apportionment and four methods of equity repayment were studied.

Repayment of Equity in Existing Works. Of the methods for repayment of equity in existing sewage works, there seems to be some agreement on the "present worth" basis, i.e., reproduction cost less depreciation and obsolescence. The staff recommends the present worth basis, specifically basis "D" as defined on p. 70 of Volume II, Part Three, without subtracting federal PWA grants. Preliminary values totaling nearly $70 million for the equities on the present worth basis were presented in Table No. 4 of Volume II and in subsequent studies, Tables 4084-20 and 21 and 4084-33a, b, c, and d. Further detailed studies would be necessary to determine more exact values for these equities for use in actual cost apportionment work.

Methods of Cost Apportionment Considered. Of the 18 methods for apportioning the costs of constructing new works, Volume II did not specifically recommend any one method, but did indicate which methods would be most equitable under various circumstances. For example, the simpler methods (1 through 5) would be equitable for a relatively small sanitary district, such as the present sanitary district or one encompassing approximately the area served under the past contract agreements. For these, the report indicates (p. 20, Volume II, Part Three) that Methods 2 or 5 would merit consideration.

Method 2 is the one now being used by the present sanitary district whereby all costs for new construction, operation and maintenance are apportioned between the two cities on the basis of the annual average dry weather sewage volume contributed by each.

Method 5 is the one which was used by the present sanitary district until 1955, whereby all construction costs were apportioned on the basis of the assessed valuations of the two cities and operation and maintenance costs on the basis of annual dry weather sewage volumes.

For a much larger sanitary district, however, taking in additional large areas for which new sewage works would have to be constructed by the district, more complex apportionment formulas would have to be used if it is desired to follow the principle that all works should be paid for "by users and properties for whose use, need, and benefit the facilities of the works are provided, approximately in proportion to the cost of providing the use and benefits of the works" (p. 66, Vol. II, part Three). This principle is followed in the methods suggested for a large sanitary district, e.g., Methods 15, 16, or 18 (pp. 18, 20, and 75-77, Vol. II, Part Three). The staff endorses this principle although recognizing some merit on the side of those who ask, "Should the municipalities located farthest from the sewage treatment plant pay all of the greater costs involved in transporting their sewage to the disposal site when the entire area benefits from centralized disposal?" (Study Guide, League of Minnesota Municipalities, November 22, 1961.)

Method 15, one of the three methods suggested in Volume II as being among the most equitable for large sanitary districts, apportions construction costs for works used exclusively by a given area to that area on an assessed valuation basis. Construction costs for jointly used sewers and treatment works are apportioned to and within the regions requiring them on the basis of proportionate capacity. Operation and maintenance costs are apportioned on the basis of annual average dry weather sewage volume (Vol. II, Part Three, pp. 6 and 75).

Method 16, is more complicated in that it attempts to allocate the charges between present users and property on an equitable basis, thus insuring that vacant property pays a share of the capacity provided for it instead of having the costs borne by current users entirely. The user's share of the construction cost of interceptor sewers would be allocated to them, on the basis of maximum wet weather sewage volume, that percentage of the total capacity occasioned by maximum wet weather sewage volume. The user's share of the construction cost of sewage treatment plants would be allocated to them, on the basis of annual average dry weather sewage volume, that percentage of the total capacity required for dry weather sewage volume. The property share of the cost of construction of all unused capacity (for the future) in all sewage works would be allocated to property on a gross area basis. Operation and maintenance charges would be allocated to users on the basis of annual average dry weather sewage volume (Vol. II, Part Three, pp. 6 and 76).

Method 18, the third method suggested as being suitable for large sanitary districts is similar to Method 16. The only difference is that the user's share of the construction cost of interceptor sewers would be allocated to them, on the basis of annual average dry weather sewage volume (instead of maximum wet weather sewage volume), that percentage of the total capacity occasioned by maximum wet weather sewage volume (Vol. II, Part Three, pp. 6 and 76).

Method 16A, a modification of the above three methods, was suggested during the lengthy discussions which were held by various groups studying the problem following publication of Volume II, Part Three, in

December 1960. This was an effort to find a method that would be easier to understand and simpler to apply, and still be equitable. Under Method 16A, construction costs would be apportioned in a manner which charges each municipality a portion of the costs of each sewage works in which capacity has been provided for the municipality, with the charge being based on the ratio that the allocated capacity for the municipality bears to the total allocated capacity in the works. Apportionment of operation and maintenance costs would again be based on annual average dry weather sewage volume. The charges for construction costs would be on the basis of the allocated capacities estimated at the time of design and construction. At regular intervals over the years, it would be advisable to reassess the capacity allocations, crediting or debiting the municipalities in accordance with their actual need and use as time goes on. In effect, this would correspond to buying and selling capacity in the system between the various municipalities, as is done in Rahway Valley, N. J., in Los Angeles County Sanitation Districts, and is done here under the present contracting system to some extent (Bloomington purchases some of Richfield's capacity, New Hope some of Golden Valley's, etc.).

Uniform Apportionment. As previously stated, there are those who argue that the costs should be spread uniformly over the entire district on the grounds that inasmuch as the entire metropolitan area would be acting jointly to solve a common problem and obtain the best solution for the area as a whole from a sanitation viewpoint, then no one should be penalized because of geographic location in the district. Proponents of this viewpoint succeeded in getting the bill, considered but not passed by the 1961 legislative session, to include provisions for the uniform distribution of costs in excess of 106% of the average (H.F. No. 2, Sec. 14, Subd. 3, Extra Session 1961). More recently, the Metropolitan Affairs Committee of the League of Minnesota Municipalities on January 3, 1962, passed a motion favoring cost allocation equally among all sewage system users in the proposed sanitary district regardless of location. Practice in other cities of the country can be found both ways, some allocating costs uniformly and some not. Table 2 contains a summary of financing procedures in some other metropolitan areas.

Staff Recommended Cost Apportionment For An Enlarged Metropolitan District. The total cost of a metropolitan project as estimated for this area is reasonable, in the opinion of the staff, and the per capita costs would be neither prohibitive nor inequitable if apportioned according to any of the suitable methods as discussed above.

The purpose of this report, however, is to furnish a more specific staff recommendation as to a choice between the various suitable alternatives. Accordingly, the staff recommends Method 16A as described above for allocation of costs in an enlarged sanitary district, with review and possible adjustment of the capacity and cost allocations at intervals determined by the governing board of the district, such intervals not to exceed five years. Application of this formula, with repayment of equity on a present worth basis, would result in annual costs to the central cities and core area suburbs (p. 52, Vol. II, Part Three) which are about equal or slightly less than those estimated for the central cities and core area suburbs to "go it alone" under estimated 1980 conditions.

4. Summary Recommendations. Although some specific recommendations have been made in the foregoing sections of this report, a choice between alternate solutions to certain facets of the problem was not made, pending discussion of other facets. This discussion now having been presented, the following summary recommendations are made:

(1) In order to adequately achieve the stated objectives in solving the long-range sewage disposal

problem of the metropolitan area, the staff recommends that the sewage be collected from the area of major concentration of population (90% or more) in an articulated sewer system tributary to a single treatment plant located below the major populated area, as typified by Project "A" in Volume III.

(2) The organizational structure under which recommendation (1) could be accomplished may be either the present Minneapolis-St. Paul sanitary district with a system of contract agreements with outside areas, or an enlarged metropolitan sanitary district. While the latter type of structure would, in the staff's opinion, lend itself to a better coordinated solution to the problem, nevertheless it is possible to obtain a satisfactory solution under a system of contract agreements. If agreement on the make-up of an enlarged sanitary district is not reached in the immediate future, the staff recommends that a solution to the problem be sought at an accelerated pace under a system of contracting with the central cities or the sanitary district. To facilitate this, it is recommended that further amendments be prepared to the present legislative act, Chapter 445, Minnesota Statutes, as amended, with expanded provisions for contracting with and construction for outside areas; for review and possible revision of existing contracts including rate structures, upon appeal by any affected

municipality; for long-range planning and construction in accordance with a master plan adopted by the board of trustees; and for representation on the board of trustees from the outside areas (suggest two additional board members appointed by the Governor or the Mayors of the central cities as is done in Detroit).

(3) If, however, an enlarged metropolitan sanitary district is the organizational structure agreed upon, the following recommendations pertain:

Boundaries. For simplification it is suggested that the initial boundaries of an enlarged district be similar to those described above under "intermediate Boundaries" (B), with provision for further expansion in the future. The initial boundaries would then encompass approximately 750 square miles and would be less than the "Ultimate Limits" developed in Volume Three (Fig. 2-20) through subtraction of the Lake Minnetonka Region, the Southeast Region, and five outer fringe townships, viz., Dayton, Eagle Creek, Oneka, Grant, and East Oakdale.

Sewage Collection and Treatment Project. Project "A," described in Volume III, is recommended as the best project to economically and satisfactorily accomplish Summary Recommendation No. (1), above, under either the contract system or an enlarged district.

Repayment of Equity in Existing Sewage Works

Jointly Used. Repayment of these equities on the basis of "present worth," specifically basis "D" as defined in Volume II, Part Three, p. 70, is recommended. Present worth is determined by computing reproduction cost, less depreciation and obsolescence for works not usable in the future.

Apportionment of Costs For New Construction and For Operation and Maintenance. For an enlarged sanitary district of a size suggested under "Boundaries," it is recommended that the cost of new construction be apportioned under Method 16A described above, whereby each municipality would be charged a portion of the costs of each sewage works in which capacity has been provided for the municipality. The charge would be based on the ratio that the allocated capacity for the municipality bears to the total allocated capacity in the works. Operation and maintenance costs would be apportioned on the basis of annual average dry weather sewage volume.

Acknowledgement. The cooperation and advice of other members of the Sanitary District staff and consulting engineers, Toltz, King, Duvall, Anderson and Associates, Inc., during the preparation of this report is gratefully acknowledged.

Respectfully submitted,

/s/ Kerwin L. Mick

KLM:c Chief Engineer and Superintendent

* * *

TABLE 1

SUMMARY OF ORGANIZATIONAL STRUCTURES IN SOME OTHER METROPOLITAN AREAS PROVIDING SEWAGE SERVICE

(Based on information in Vol. II, Part Two)

Central Cities Providing Service to Outside Areas by Contract Agreement or Ordinance	Metropolitan Sanitary Districts or Sewer Authorities
Cincinnati	Boston
Cleveland	Chicago
Detroit	Green Bay, Wis.
Los Angeles	Madison, Wis.
Philadelphia	Milwaukee
Portland	St. Louis
Toledo	Buffalo
Washington, D. C.	Pittsburgh (1)
	Rahway Valley
	Seattle (1)

(1) Although these are metropolitan authorities, long term sewage disposal contracts were executed with each area outside the central city to back up the sale of bonds.

TABLE 2

METHODS OF COST APPORTIONMENT
FOR SEWAGE SERVICE
IN SOME OTHER METROPOLITAN AREAS

(Based on information in Vol. II, Parts Two and Three)

All Costs Based On Assessed Valuation. (Vol. II, Method No. 1)

Chicago - (Uniform millage rate in entire district; new areas in expanded district pay nothing for equity in works previously constructed and paid for by others.)

Green Bay, Wis. - (Basis equalized assessed valuations.)

All Costs Based on Sewage Volume. (Vol. II, Method No. 2)

Cincinnati - (A surcharge is levied for wastes stronger than "normal sewage." Outside areas pay same rates as in the city.)

Pittsburgh - (A surcharge is levied for wastes stronger than "normal sewage" and for garbage grinders. Outside areas pay about double the district basic charge.)

All Costs Based on Uniform Monthly Service Charge.

Seattle - (Fixed charges and operating costs obtained from monthly service charge of $2.00 per residential or equivalent connecton.)

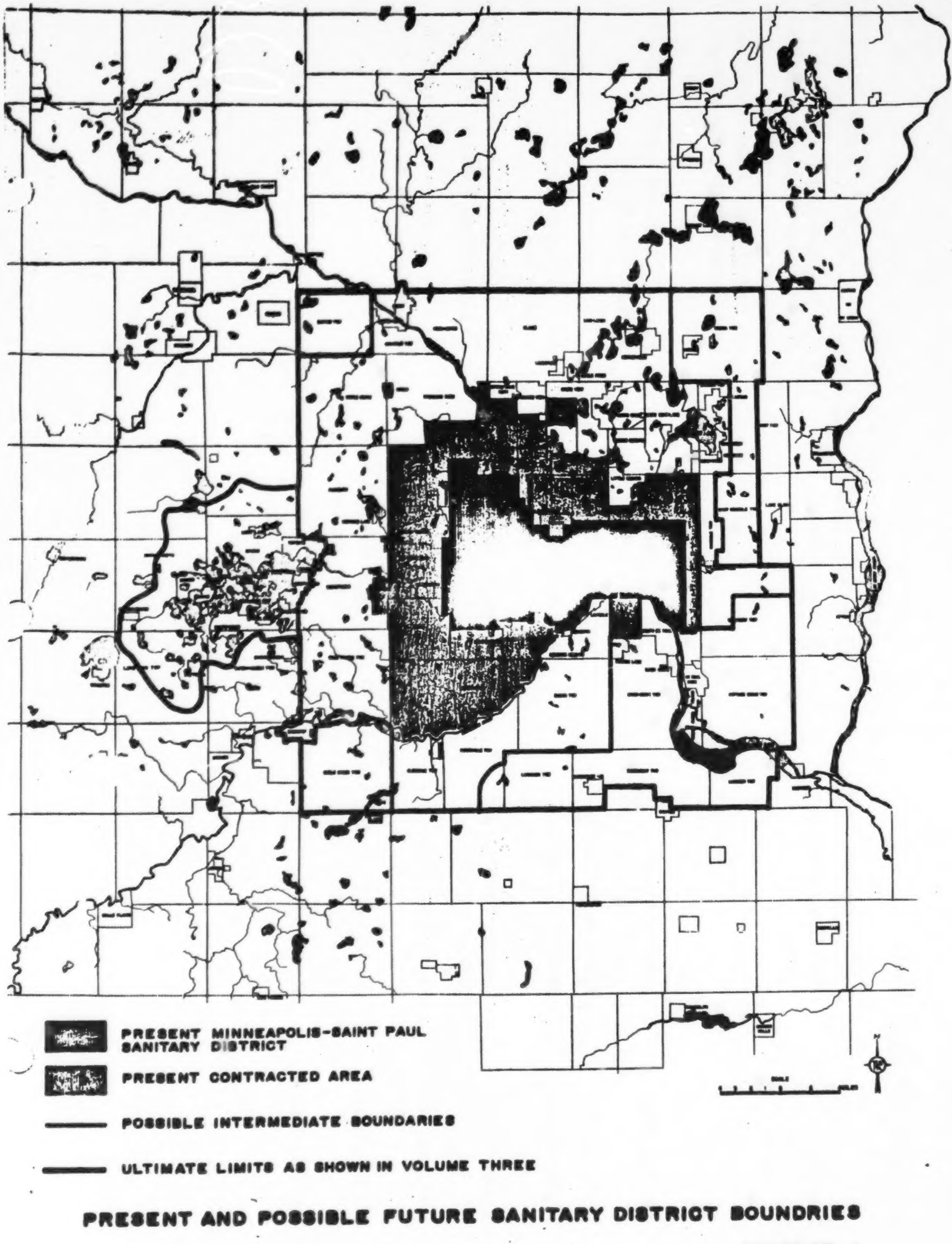
Combined Methods.

	............Basis of Apportionment..............		
	Construction Costs	Operation & Maintenance	Outside Areas
Boston	Property Valuation	Population	
Cleveland	Assessed Valuation for Bonds Issued Prior to 1939. Sewage Volume Thereafter	Sewage Volume	Pay $3\frac{1}{2}$ to $4\frac{1}{2}$ times the city rate.

Table 2 - Cont.

Combined Methods - Cont.

	............Basis of Apportionment...........		
	Construction Costs	Operation & Maintenance	Outside Areas
Detroit	Allocated Capacity	Sewage Volume	Pay transportation charge for use of city trunks, based on original cost per unit of capacity. Rate for use of main interceptors and treatment works same as rate in the city.
Los Angeles	General Fund (Ad valorem tax, sales tax and other sources)	General Fund	Pay on allocated capacity and sewage flow basis.
Milwaukee	Assessed Valuation	Sewage Volume	
Philadelphia	Allocated Capacity	Sewage Volume	Allocated capacity and sewage volume basis.
Toledo	Sewage Volume and Connection Charge	Sewage Volume	Pay 1.4 times the city rate, plus an infiltration charge.
Washington, D. C.	Allocated Capacity	Sewage Volume	Pay for equity in existing works, otherwise same as rate in the city.
Madison, Wis.	Principally sewage volume, also general tax levy and assessments on an area and front footage basis.		
Rahway Valley, N. J.	Allocated Capacity	Sewage Volume and Strength	


PRESENT MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT
PRESENT CONTRACTED AREA
POSSIBLE INTERMEDIATE BOUNDARIES
ULTIMATE LIMITS AS SHOWN IN VOLUME THREE
SCALE
MILES

PRESENT AND POSSIBLE FUTURE SANITARY DISTRICT BOUNDRIES

FIGURE NO.—1

1327

EXHIBIT "C"

KERWIN L. MICK
CHIEF ENGINEER AND SUPERINTENDENT

PHONE: PR. 1-8845

D. D. WOZNIAK
ATTORNEY

MINNEAPOLIS - SAINT PAUL SANITARY DISTRICT
2400 CHILDS ROAD
SAINT PAUL 6 :: MINNESOTA

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LOUIS J. BARTSCHER,
EXECUTIVE SECRETARY

ADDRESS ALL COMMUNICATIONS
TO THE SECRETARY UNLESS
OTHERWISE REQUESTED

May 28, 1962

Robert N. Barr, M.D., Secretary
Minnesota State Board of Health
Minnesota Water Pollution Control Commission
University Campus
Minneapolis 14, Minnesota

Gentlemen:

Relative to your proposed classification and adoption of water quality standards for the Mississippi River in the Minneapolis-Saint Paul area, this sanitary district submits the attached statement.

Very truly yours,

Kerwin L. Mick

Kerwin L. Mick
Chief Engineer & Superintendent

Approved by the Board of Trustees
May 25, 1962

MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT

STATEMENT FOR PRESENTATION
AT HEARING OF
MINNESOTA STATE BOARD OF HEALTH
MINNESOTA WATER POLLUTION CONTROL COMMISSION

May 28, 1962

The District's Interest in Proposed Standards

We believe your commission is to be commended for proposing river water quality standards rather than waste effluent standards. By so doing, you will specify the desired river conditions and leave some incentive to accomplish other measures which would help achieve the desired conditions, such as low flow augmentation.

The Minneapolis-Saint Paul Sanitary District has a vital and direct interest in the proposed classification and adoption of standards for the Mississippi River in the vicinity of Minneapolis and St. Paul. The District's principal area of control involves that section of the river from the Pigs Eye Lake Sewage Treatment Plant to the mouth of the St. Croix River. Into this zone of the river, the effluent from the District's treatment plant is discharged, utilizing the natural assimilative capacity of the river for the completion of the stabilization process. As the sewerage system tributary to the District's treatment plant serves over 90 percent of the Metropolitan Area's sewered population, the plant effluent is the major source of pollution in the down-river section. Other communities and industries also contribute substantial pollutional loads to the river and share the responsibility for the river water conditions which prevail.

Because of the direct bearing of the extent and cost of sewage treatment on the maintenance of various levels of quality of the river water, the District endorses reasonable standards for river water quality which are commensurate with the downriver water uses. It is however an economic necessity to make reasonable use of the diluting and natural purification afforded by the receiving stream.

In the section of the river between St. Anthony Falls and the sewage treatment plant, the District's interests in the proposed standards are less direct than in the lower section, but are also important. The quality of the river water above the treatment plant influences the degree of treatment required at the plant, and therefore the District is concerned with overflows from combined sewers and other waste discharges above the plant, and with the condition of both the Minnesota and Mississippi Rivers.

About two miles above the treatment plant, a sewage bypass structure provided as part of the original intercepting works at Third and Commercial Streets permits the bypass of the flow in the Main Joint Interceptor to the river during emergency periods. The occasional utilization of this bypass facility is essential to the proper maintenance of the treatment works.

Treatment Objectives of Past Years

Placed in operation during the summer of 1938, the treatment plant at Pigs Eye Lake was designed to provide treatment for an average sewage flow of 134 million gallons per day expected from a tributary population of 910,000.

Because of the wide variation in the discharge of the Mississippi River which receives the plant effluent, the plant was designed to provide primary treatment during normal river flow and intermediate treatment by chemical precipitation during unusually low river flow conditions.

The operation of the plant and the system of intercepting sewers has been aimed toward the abatement of pollution and the maintenance of reasonable river water conditions through and below the Twin Cities. In recent years, the annual cost of operation and maintenance of the plant has exceeded one million dollars.

Treatment objectives were based upon a statement of requirements issued by the Minnesota State Board of Health in 1928. The statement provided essentially that the pollution of the river should be restricted to such an extent that the public health hazard would be reduced to a minimum, that the health of livestock would not be endangered, that the public nuisance would be eliminated, and that fish life in the river, at least below the mouth of the St. Croix, would not be jeopardized. These objectives subsequently were interpreted by the Metropolitan Drainage Commission and Minneapolis-Saint Paul Sanitary District engineers as meaning that practically all the sewage should be collected and conducted to a treatment plant located downstream from the densely populated areas. Interpretation of the requirements was also made in terms of the minimum dissolved oxygen levels which would be maintained in the Hastings Pool and in the Mississippi below the junction of the St. Croix.

A complete resume of these requirements and their interpretation is presented as Appendix I of this statement.

Over the years the District has established approximately 24 river water sampling stations which extend 93 miles from North Minneapolis down through Lake Pepin. Annually more than 600 regularly scheduled river samples are collected and over 5,000 analytical determinations of the water quality are made.

Program of Research and Investigation

In May of 1956 the Board of Trustees of the Minneapolis-Saint Paul Sanitary District authorized a five-year Program of Research and Investigation to assist in the determination of future requirements for Sanitary District sewage works. The overall program was directed toward the determination of the most economical and satisfactory solution to the sewage disposal problem of the Minneapolis-Saint Paul Metropolitan Area. The research phase of the program included comprehensive analysis of the past thirty-five years' records of river conditions and the prediction of the capacity of the Mississippi and Minnesota Rivers to receive and assimilate the pollution discharged from sewage treatment plants and other sources in the area. The investigation part of the program involved a systematic evaluation of the existing interceptor sewer system to determine its adequacy to convey expected future flows from an enlarged area of service and the development of a long-range plan for the expansion of sewage works in the Metropolitan Area.

All reports prepared as a part of the Program of Research and Investigation have been previously submitted to the Water Pollution Control Commission. As these reports relate directly to the subject of this hearing, we are presenting as exhibits those which are applicable as follows:

The report entitled "Pollution and Recovery Characteristics of the Mississippi River for the Period 1926-1955" - Volume One - Part One (January, 1958) which presents a detailed analysis of deoxygenation characteristics of the river, the frequency of occurrence of dissolved oxygen values, and an analysis of the bacteriological quality of the river was prepared by the Sanitary Engineering Division of the Civil Engineering Department of the University of Minnesota.

The report "Pollution and Recovery Characteristics of the Mississippi River" - Volume One - Part Three (September, 1961) is a report of the Sanitary District prepared by the Sanitary Engineering Division of the Civil Engineering Department, University of Minnesota. This report presents an investigation of the characteristics of the Mississippi and Minnesota Rivers in the vicinity of Minneapolis and Saint Paul, deoxygenation rate constants for the receiving rivers and the treatment process effluents, the reaeration of the receiving rivers, the capacity of the rivers to assimilate pollution, the degree of treatment to maintain dissolved oxygen levels, and methods of supplementing the dissolved oxygen content of the Mississippi River downstream of the treatment plant effluent additions.

The "Expansion of Sewage Works in the Minneapolis-

Saint Paul Metropolitan Area" - Volume Three (September, 1960), a report prepared by Toltz, King, Duvall, Anderson and Associates, Incorporated, includes preliminary plans and estimates of cost of alternate sewage works projects for an extensively enlarged service area.

The "Report on Activated Sludge Pilot and Demonstration Plant Test Program" - Volume One - Part Two (August, 1961), a final report on an investigation conducted by the Sanitary Engineering Division, Department of Civil Engineering, University of Minnesota, has been used in this investigation of sewage treatment works requirements. The report summarizes the results of thirty-six months of pilot and demonstration plant tests of the activated sludge process and its modifications.

"Report on the Expansion of Sewage Treatment Works in the Minneapolis-Saint Paul Metropolitan Area" - Volume Four (November, 1961) by Toltz, King, Duvall, Anderson and Associates, Incorporated, presents an investigation of the expansion of the Pigs Eye Lake Sewage Treatment Plant covering a determination of the required degree of treatment; the applicability and feasibility of various methods of sewage treatment and sludge disposal; and the development of a design basis, preliminary plans and cost estimates for the expansion of the treatment works.

Proposed Expansion of Treatment Plant

At a recent meeting of the Board of Trustees, a three-year construction program was adopted which is aimed at the completion of a large expansion project and the commencement of secondary treatment operations in 1965. Final contract plans are presently being prepared for this treatment plant enlargement, based upon employment of the high-rate activated sludge process. The estimated cost of this expansion project is $21,710,000. The Minneapolis-Saint Paul Sanitary District is, therefore, actively proceeding with treatment works which, when completed, will result in improved river conditions and substantial compliance with the proposed river standards.

Proposed River Standards

With our engineering staff and our consulting engineers, we have reviewed the standards as proposed for three sections of the Mississippi River. Based upon the extensive studies of the pollution and recovery characteristics of the river made as a part of the Program of Research and Investigation, knowledge of the workings of the main sewerage system of the Metropolitan Area, and the experience of administering and operating the present sewage treatment plant, we concluded that the proposed standards, if interpreted as objectives to be achieved gradually over a period of years, are reasonable and proper.

The minimum dissolved oxygen requirements appear to be consistent and reasonable in all three zones, as do the maximum limits on the concentrations of various waste chemicals. In the upper zone, the rather strict requirements to prevent new pollution and eliminate existing pollution are recognized by this Sanitary District as being necessary to protect the increasing use of this section of the river as a source of water supply for a large number of people.

The existence of a considerable number of overflow outlets from old combined sanitary and stormwater sewers in the two upper zones, however, will make it expensive and require a long-range program before the central cities could comply entirely with the proposed standards for those two zones. Combined storm water and sewage systems were constructed in the two cities many years ago before sewage treatment was considered necessary. In 1957 there were some 21 such outlets in the Minneapolis sewer system and 34 in St. Paul. Provision of contact chambers and equipment for disinfecting the overflow to the river from these outlets would be an extensive and very costly project.

Complete separation of the combined sewer systems into separate storm sewers and sanitary sewers would also be a very expensive project for which this sanitary district has made no specific cost estimates. Those sewers are owned and operated by each city. Both cities have, however, accomplished some separation in the past few years, especially Minneapolis. The latter city has now separated more than half of its sewered area and could probably complete the separation in the upper zone in a relatively short time. There are only seven overflow outlets in this upper zone, which is the most critical zone from the viewpoint of protection of water supplies. There are some 48 overflow outlets in the second zone, 14 in Minneapolis and 34 in St. Paul.

In the intermediate zone, the present location of an emergency bypass of the main Sanitary District Interceptor, we call attention that provision of facilities for the disinfection of the very infrequent discharge from this outlet cannot be considered as economically justified.

Because the Minnesota River enters the Mississippi at St. Paul and has a considerable effect on the condition of the Mississippi through and below St. Paul, we urge you to consider establishing water quality standards for the Minnesota River also.

In summary, this Sanitary District endorses the proposed water quality standards as objectives to be achieved gradually over a period of years, because of the large expenditures and time-consuming construction which would be required. The recently approved twenty-two million dollar program of plant expansion is a step toward compliance with these proposed standards.

Prepared for Board of Trustees
By
/s/ Kerwin L. Mick
Chief Engineer & Superintendent

* * * *

APPENDIX NO. 1

PRESENT OBJECTIVES FOR RIVER WATER QUALITY IN THE MINNEAPOLIS-SAINT PAUL AREA

River water quality objectives which apply to the Mississippi River downstream from Saint Paul are based upon a statement of requirements issued in 1928 by the Minnesota State Board of Health. At that time, the State Board of Health, cooperating with the Minnesota Commissioner of Game and Fish and the Wisconsin State Board of Health, in replying to an inquiry from the Metropolitan Drainage

Commission, presented the following statement (page 142-3, 1928 Report, Minnesota State Board of Health, as published with the "Second Report of the Metropolitan Drainage Commission" - 1928):

"That the pollution of the river (Mississippi) should be restricted to such an extent that the public health hazard will be reduced to a minimum, that the health of livestock will not be materially endangered, that the present public nuisance will be eliminated, and that fish life in the river, at least below the mouth of the St. Croix, will not be jeopardized."

"In order to accomplish these results, it will be necessary at least to collect a very large part of the sewage and industrial wastes from the Metropolitan Area embracing Minneapolis, Saint Paul, South St. Paul, and Newport and the populated areas adjacent thereto, and to treat the sewage and industrial wastes so that the pollution of the river will be restricted to the extent above indicated. Such additional measures as may be required to restrict the pollution below the Metropolitan Area can best be determined after further investigation."

"It may not be found possible to maintain

> that portion of the river above the junction with the St. Croix River in such a condition that it can be used for fish cultural purposes. This is due to certain variable factors, such as sudden stream flow fluctuations, the wide variations in the quantity and strength of sewage and industrial wastes and the unforeseen contingencies which may sometimes interfere with the normal operation of sewage treatment works."

These objectives were interpreted by the Metropolitan Drainage Commission and by the Minneapolis-Saint Paul Sanitary District engineers to mean that practically all the sewage should be collected with intercepting sewers and conducted to a treatment plant located as far downstream from the more densely populated areas as feasible, where the sewage could be treated and the plant effluent disinfected to destroy pathogenic organisms. The Sanitary District established the minimum dissolved oxygen levels for the Hastings Pool of the Mississippi River which would meet the State Board of Health requirements. Subsequently, these determinations were employed as the basis for the design of the existing sewage treatment plant. As presented in the "Second Report of the Minneapolis-Saint Paul Sanitary District" - 1934 (page 31), the dissolved oxygen criteria are as follows:

"(1) Two parts per million of dissolved oxygen shall be maintained 90 percent of the time for each of the various summer months. In the computation the months were taken cumulatively throughout the 43-year period for which discharge records are available and based upon average monthly river discharge at Saint Paul. Each calendar month was considered separately; for instance, the May discharge records for the entire period were considered independently of the records for other months, and 43-year flow duration curves for each month were prepared. The monthly average discharges, exceeded 90 percent of the time and used as criteria, were read from these curves."

"(2) One part per million of dissolved oxygen shall be maintained 100 percent of the time during each of the various summer months. In the computation the months were taken cumulatively throughout the 43-year period of discharge records and based upon average monthly discharge records at Saint Paul. Each calendar month was considered separately, as explained in the previous paragraph."

"(3) A trace of dissolved oxygen shall be "maintained during periods of absolute minimum flows prevailing for periods of 3 to 5 days."

"The degree of treatment shall be increased above that required to meet the above standards if they do not permit the maintenance of about four parts per million dissolved oxygen below the St. Croix."

* * *

EXHIBIT D

REGULATION OF THE MISSISSIPPI RIVER HEADWATERS RESERVOIRS

A STATEMENT PRESENTED BY THE MINNEAPOLIS-SAINT PAUL
SANITARY DISTRICT
at the
Public Hearing
Called by the
U. S. Army, District Engineer, St. Paul, Minnesota
at
GRAND RAPIDS, MINNESOTA
June 27, 1962

KERWIN L. MICK
CHIEF ENGINEER AND SUPERINTENDENT

PHONE: PR. 1-8845

D. D. WOZNIAK
ATTORNEY

MINNEAPOLIS - SAINT PAUL SANITARY DISTRICT
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LOUIS J. BARTSCHER,
EXECUTIVE SECRETARY

ADDRESS ALL COMMUNICATIONS
TO THE SECRETARY UNLESS
OTHERWISE REQUESTED

June 25, 1962

W. B. Strandberg, Colonel
Corps of Engineers, District Engineer
U. S. Army Engineer District, St. Paul
1217 U. S. Post Office and Custom House
St. Paul 1, Minnesota

Re: Mississippi River Headwaters Reservoirs

Dear Sir:

In response to your May 28 notice of public hearing to be held June 27, 1962 at Grand Rapids, Minnesota, this Sanitary District submits the attached statement on the regulation of the Mississippi River Headwaters Reservoirs. The statement was prepared with the assistance of the District's consulting engineers, Toltz, King, Duvall, Anderson and Associates of St. Paul and advisory consultant, George J. Schroepfer of Minneapolis.

The statement shows the relationship between low river flow augmentation and the degree of sewage treatment and indicates that even if the most complete form of sewage treatment is installed, augmentation of low flows in the river will be necessary to maintain satisfactory water quality. It points out the increasing national recognition of the need for low stream flow augmentation to assist in attaining adequate sewage disposal. For example, Report No. 29 of the Senate Select Committee on National Water Resources dated January 30, 1961, states that, "even when advanced practices for waste treatment are applied, large quantities of water are needed for waste dilution, if quality standards are to be maintained which safeguard domestic supplies and permit use of lakes and streams for outdoor recreation purposes and for fisheries."

With the Headwaters Reservoirs now being utilized at less than half of their total usable capacity, the statement suggests the possibility of increased utilization without serious detriment to recreational and other interests in the reservoir area. Of the six Headwaters Reservoirs, Winnibigoshish and Leech have by far the largest storage capacity. It appears reasonable for the purposes of this statement to exclude Pokegama, Sandy, Pine, and Gull from consideration as a significant source of stored water.

With more than half the population of the state expected to be concentrated in the Minneapolis-St. Paul metropolitan area before 1980, it becomes imperative to secure adequate stream flow for water supply, stream sanitation and other needs. The sanitation situation will be further aggravated if a 12-foot navigation channel is constructed, as compared with the present 9-foot channel.

In 1961 this Sanitary District completed a 5-year study costing half a million dollars to evaluate the present and future sewage disposal problem in the metropolitan area and to provide information leading to the best engineering solution. Four of the reports on this study are submitted with this statement. In June 1961, the Board of Trustees of this Sanitary District authorized the design of a secondary treatment plant for an average sewage flow of 218 million gallons daily, which will more than double the present degree of treatment, with construction now scheduled for completion during 1965 at an estimated cost of 2[illegible] million dollars.

Preliminary studies by your Army Engineers St. Paul District office, reported to this Sanitary District by letter of June 22, 1960, indicate that a considerable amount of low flow augmentation from the reservoirs is practicable. Cost estimates contained in the Sanitary District statement submitted herewith indicate that reasonable amounts of low flow augmentation would effect savings in sewage treatment costs ranging from $750 to $2,700 per day and are necessary in any event if the desirable water quality objectives are to be met.

The Minneapolis-Saint Paul Sanitary District hopes and believes that the study currently being made by the U. S. Army Corps of Engineers will result in reasonable low river flow augmentation from the Headwater Reservoirs as a regular operating procedure, without excessive detriment to local interests in the reservoir area.

Very truly yours,

/s/ Kerwin L. Mick

Chief Engineer and Superintendent

KLM:j

Approved by the Board of Trustees this date.

Copies to Minnesota Congressional Delegation.

* * *

A. INTRODUCTION

The Minneapolis-Saint Paul Sanitary District and its predecessor, the Metropolitan Drainage Commission, have maintained a continuous interest in the matter of regulation of the headwaters reservoirs for more than 30 years. The position of the Sanitary District is that stream sanitation, or effluent dilution, is one of the basic beneficial uses of the waters of the Mississippi River, along with water supply, navigation, flood control, power, recreation, fish and wildlife, and wild rice cultivation. This statement is limited primarily to the effects of low flow augmentation on the degree of sewage and waste treatment necessary to maintain desirable standards of water quality.

The need for low flow augmentation as well as expansion of sewage treatment works has become apparent with the rapid growth in this metropolitan area experienced in the past 10 years and likely to continue in the future. In 1930 the population in the metropolitan area comprised 36% of the state population. By 1960 this had increased to 45%; in 1980 it is estimated that this value will be 52%, increasing to 59% in the year 2000. The study area population as a basis of sewage works planning was 830,000 in 1930, and had increased to 1,390,000 in 1960; corresponding values for 1980 are 2,140,000 and for the year 2000, 2,740,000.

The various uses of the waters of the Mississippi River are interrelated, and have varying effects on each other. As an illustration, the construction of Lock and Dam No. 1 in 1914, and the construction of Locks and Dams Nos. 2 and 3 in the early thirties had a very marked effect upon the stream sanitation situation, to which reference was made in several of the reports of the Metropolitan Drainage Commission, the Minneapolis-Saint Paul Sanitary District, the Minnesota Department of Health, and the U. S. Public Health Service. The construction of these dams retarded the velocity of flow, with the result that the pollution situation through and for a distance below the metropolitan area was markedly aggravated. Their construction, however, made it unnecessary to employ the headwater reservoirs in the interest of navigation to the former extent, and greater emphasis was placed on the maintenance of more uniform levels in the six headwater reservoirs to meet local requests for such uniformity.

This sanitation situation will be further aggravated if a 12-foot navigation channel is constructed by raising the pool elevations in the three pools referred to. The possibility of a 12-foot navigation channel as it affects the Minneapolis-Saint Paul Sanitary District Sewage Treatment Works, was the subject of an earlier statement submitted to the District Engineer on September 10, 1945. It is mentioned here for the purpose of showing the interacting effect of construction and operation for navigation purposes on the sewage treatment requirements and water quality attainments of this Sanitary District.

B. HISTORICAL BACKGROUND

The Minneapolis-Saint Paul Sanitary District and its predecessor organization, the Metropolitan Drainage Commission, for the past 30 years have been vitally interested in the method of operation of the headwater reservoirs and the resulting effect on the problem of sewage and industrial waste disposal in the metropolitan area.

Both have an effect on costs, as well as the quality of the river water downstream from this metropolitan area. This interest is shown by the fact that statements were presented at public hearings held at the call of the St. Paul District Engineer, on January 22, 1931, March 28, 1935, and January 16, 1945. In addition, the Sanitary District has communicated with the District Engineer at St. Paul on several occasions when critical low flow conditions obtained in the Mississippi River at St. Paul. The Sanitary District also submitted a statement at a January 26, 1960 meeting of the Upper Mississippi Reservoir and Minnesota River Valley Development Commission, a state legislature interim commission.

Because of marked pollution conditions in the Minneapolis and St. Paul stretch of the river, aggravated by the construction of navigation dams No. 1 and No. 2, the Sanitary District was created by the 1933 Legislature and in 1934 began the construction of a system of sewage works designed to alleviate the unsatisfactory conditions. The treatment plant was placed in operation in June of 1938. Since that time the rapid growth in this metropolitan area previously discussed has made it necessary for the Sanitary District to consider expansions of its sewage works. In May, 1956, the District inaugurated a 5-year program of investigation and research designed to provide information leading to the best engineering solution to this problem.

This investigation resulted in the preparation of a number of final reports, four of which are considered pertinent to this statement, and are submitted herewith for the record. These are entitled: "Pollution and Recovery Characteristics of the Mississippi River," Vol. 1, Part 1, dated January 1958, and Vol. 1, Part 3, dated September 1961. Also included are Vol. 3 and Vol. 4, entitled "Report on the Expansion of Sewage Works (and treatment works) in the Minneapolis-Saint Paul Metropolitan Area," dated September 1960 and November 1961, respectively.

As a consequence of this investigation and as a basis for the first stage expansion of the sewage treatment plant, the Board of Trustees on June 26, 1961, authorized the preparation of the plans for a treatment plant of the high-rate activated sludge type designed to serve the central cities and twenty-four presently committed suburbs tributary to the Minneapolis-Saint Paul sewer system. The plant is expected to cost approximately 23 million dollars and is being designed for an average sewage flow of 218 million gallons daily, expected from a sewered population equivalent of 2,610,000 in the year 1980. It is a modification of the original project I-10 and is in conformance with Project A in the 5-year study. The plant can be readily enlarged when necessary to serve additional areas. The Board of Trustees on April 9, 1962, adopted a budget providing for the first year (1963) of construction on the expansion project which is expected to be completed during 1965.

The treatment plant is being designed to provide for a removal of organic matter, expressed as BOD (biochemical oxygen demand) of 75%, of suspended solids 85%, and of bacteria expressed as coliform organisms of 99.9+%. This is essentially the type and degree of treatment that is provided at several of the New York City plants, and at the Philadelphia and Washington, D. C. plants, among others.

C. RECOGNITION OF LOW FLOW AUGMENTATION FOR STREAM SANITATION AS A BENEFICIAL USE

The Metropolitan Drainage Commission and the Sanitary District through statements submitted at previous hearings conducted by the District Engineer since 1931 have consistently maintained that river sanitation should be considered as a beneficial use of the water resources similar to navigation, flood control, power, water supply, recreation, etc. In fact, the Sanitary District feels that with the provision of a satisfactory and reasonable degree of sewage treatment, this is one of the higher uses.

A number of other organizations and experts in the field of water resources have arrived at the same conclusion. A few of these sources will be cited. In a report dated January 1961, entitled "Report No. VI of the Low-Flow Augmentation Project" to the National Institutes of Health, U. S. Public Health Service, prepared by Johns Hopkins University, the following statement is made:

> "The release of water from multiple-purpose reservoirs for stream sanitation is a beneficial water use which has received relatively little support in the past. It appears that this conservation measure is destined to become more important in the future. Increasing waste loads from growing population centers and expanding industries will inevitably cause stream-pollution problems which, unless solved, will endanger the health, welfare, and economy of large areas, and indeed, of the entire nation. The increasing importance of these stream-pollution problems demands that all possible avenues of correction be explored thoroughly to provide the best overall solution for each case."

In 1950 the President of the United States established the President's Water Resources Policy Commission and instructed it to study existing Federal legislation and policies in the water resources field. The following is a summary of a statement concerning this which was included in the report on low flow augmentation referred to above:

The President's Water Resources Policy Commission, in its own summary of the reviews submitted by the various Federal agencies, noted that:

> "In some cases, it has been found that aggravated pollution conditions can be abated most economically by primary sewage treatment plants augmented by increased low flow of rivers with upstream storage reservoirs to increase the low flow of rivers ..."

In its report submitted to the President (December 1950), the Policy Commission outlined a recommended water policy for the nation. Two of the principles set forth are quite pertinent to this study, as follows:

> "Pollution control should be considered in the planning of river basin programs. It should be recognized as a major contribution to the Nation's objectives in the fields of water supply, recreation, and fish and wildlife ..."

and

> "Multiple-purpose reservoirs should, as far as consonant with other major purposes, be planned and operated so as not to aggravate but to contribute to the control of pollution. This should include

"regulation of releases of water to make fullest use of the stream's potential self-purification capacity, with advance determination of the schedule of releases to permit proper classification of the stream by the Public Health Service for pollution control purposes."

The same report quotes a statement from a report on the economic evaluation of projects by the Federal Inter-Agency River Basin Committee, published in 1950. The methods of evaluation relative to pollution abatement were summarized as follows:

"Corps of Engineers' Practice on Navigation, Flood Control and Multi-Purpose Projects

"Benefits measured by the cost of providing the most economical alternative methods of waste treatment or disposal, or reduction in maintenance and operating cost, where alternative methods of pollution abatement are not economical."

Report No. VI points out that another milestone in the development of Federal water policy was reached in December 1952 with the issue of the Bureau of the Budget's Circular A-47. Circular A-47 directs that the economic evaluation of a program or project shall include an estimate of the primary benefits. Among those primary benefits are those resulting from: "... the reduction in the cost of pollution abatement by stream flow augmentation. Such benefits should be calculated as the residual benefits possible after allowing for all direct measures to control pollution at the source that would normally be required or considered necessary by the Public Health authorities concerned."

Circular A-47 points out in paragraph 9 that a valuation of the cost of a program or project "shall include a statement of economic costs expected to be induced by the program or project such as the costs of: a. . . . . . . b. decreased value of . . . water quantity or quality and other water or related land resources, where not reflected in market values, and c. rectifying adverse effects upon sanitation, transportation, . . ." This circular lists those purposes to which costs may be allocated. These are:

"1. Flood control
2. Reclamation
3. Navigation
4. Watershed management
5. Electric power and energy
6. Domestic, municipal, or industrial water supply
7. Recreational development
8. Fish and wildlife development

9. Pollution control or abatement"

A summary statement in Report No. VI contains the following: "The foregoing discussion of Public Water Policy can be summed up briefly. Both Federal and State agencies and officials generally have recognized low flow augmentation for pollution abatement as a beneficial use of water. Federal Water Policy calls for consideration of pollution abatement as a potential function of government projects, but prohibits the development of water resources for this purpose at Federal expense."

At its annual meeting in February, 1959, the Mississippi Valley Association adopted a broad statement on water pollution policy. "America's water pollution control program must recognize the multi-purpose nature of our water resources, including the use of this nation's streams for the carrying of treated wastes." The committee's report goes on to state, "The Association has embarked on a pollution control program because pollution abatement is considered by the organization to be an essential and inseparable component of this nation's water resource management program - fully as important as dams to store water, channels to make our streams navigable, and conservation farming to prevent erosion."

Report No. 29 of the Senate Select Committee on National Water Resources, dated January 30, 1961, contains the following at the beginning of its summary statement:

> "The foregoing summarization of the situation with respect to the nation's water resources indicates that serious problems lie ahead. Adequate measures must be adopted to deal with situations that can now be foreseen to make sure that shortages of water will not control the future destiny of the nation. The provision and management of water supplies for waste dilution, irrigation of arid lands, outdoor recreation, and the conservation of fish and wildlife appear to pose the most serious water problems, for the following interrelated reasons:
>
> "1. Even when advanced practices for waste treatment are applied, large quantities of water are needed for waste dilution, if quality standards are to be maintained which safeguard domestic supplies and permit use of lakes and streams for outdoor recreation purposes and for fisheries.
>
> "2. ...."

In a letter to Colonel Strandberg, District Engineer of St. Paul, dated March 28, 1962, Dr. Robert N. Barr, Secretary of the Minnesota Water Pollution Control Commission stated in part: "The Commission feels that augmented stream flow should not be a substitute for but rather a supplement to operation of sewage and waste "treatment facilities at their maximum capability. However, the establishment of a regulated minimum discharge is of vital economic importance to the municipalities and industries depending upon the Mississippi River for dilution of treated effluent, particularly those in the Twin Cities Metropolitan Area." The Sanitary District concurs in this statement. It proposes to enlarge and to increase the degree of treatment provided in the present plant at an expenditure of $23,000,000 for construction in the next three years, and to operate the expanded plant at its maximum capability.

D. THE HEADWATER RESERVOIRS

In the period from 1884 to 1913 the Federal Government constructed a system of storage reservoirs at the headwaters of the Mississippi River, which now number six, namely, Winnibigoshish, Leech, Pokegama, Sandy, Pine, and Gull. These reservoirs were originally constructed in the interest of navigation downriver from Minneapolis, with secondary usage for flood control. With the completion of the locks and dams at Hastings and below in 1936, the utilization of the reservoirs for navigation became relatively unimportant. In fact, the present requirements are limited feet per second, or second feet) during the maximum months of river traffic.

The total usable capacity of these reservoirs is approximately 828,000 second foot days. (A second foot day is the volume of water corresponding to a flow of one cubic foot per second for a period of 24 hours.) The normal operating capacity is now stated to be approximately 480,000 second foot days. The reservoirs are operated under War Department regulations dated February 4, 1936. At that time the desired minimum storage was set at 313,000 second foot days, but subsequent revisions resulted in a reduction to 258,000 second foot days on April 1, 1945, with a slight increase to 265,000 second foot days ordered in effect on September 1, 1952. In the period from 1931 to 1955 inclusive, the storage available at the end of the year varied from a low of 64,000 in 1934 to a high of 659,000 in 1944.

Winnibigoshish and Leech Lake reservoirs have by far the largest storage capacity. The other four reservoirs have considerably lesser amounts per foot of drawdown. Because of its proximity to the Minneapolis-Saint Paul Metropolitan area, Pokegama Reservoir is valuable, however, for immediate discharge of stored water which could be restored when releases from Winnibigoshish and Leech reach there approximately two weeks later. It appears reasonable for purposes of this statement to exclude Sandy, Pine and

Gull reservoirs from consideration as a significant source of stored water. The two principal reservoirs of practical significance therefore in the matter of low flow augmentation are Winnibigoshish and Leech. Together they have a storage capacity of 95,000 second foot days per foot of water at ordinary operating levels, which would provide for a release of approximately 1,600 cfs. for a period of 60 days. As will be shown later the water represented by even as little as one foot of drawdown would be of significant assistance in meeting an extreme low water crisis in the metropolitan area. Greater drawdowns would sometimes be necessary.

To illustrate the physical and operating features of one of these reservoirs, the following additional details are provided concerning the Winnibigoshish Reservoir. The dam regulating the flow from this reservoir was designed for a stage of 14.2 feet, which is designated as "full reservoir level." Flowage rights, however, were secured to a level of 18 feet. The minimum level in this reservoir as established in 1931 is 6 feet. Under the present regulations a total of 8.2 feet of variations might be considered the maximum available. However, the normal minimum stage is 8 feet and the normal maximum 12 feet, although where possible in the recent past the desirable operating ranges have been aimed at the range from 8 feet to 10-½ feet, or a variation of only 2-½ feet, compared to the 8.2 feet permissible even under the present operating regulations and physical design facilities. In the period from 1884 to 1957, the average annual variation in stage has been 3.75 feet, with a maximum range in one year of 8.6 feet, and a minimum of 1.1 feet. In the period from 1938 to 1957 which were generally wet years, the average range has been 3.3 feet, with a variation from a minimum of 1.8 to a maximum of 5.3 feet. Another feature of this reservoir of interest is the storage capacity per foot in the normal operating range, viz., 33,000 second foot days. The in-flow into this reservoir has averaged 179,000 second foot days, with a minimum of 28,000 in 1934, and a maximum of 496,000 in 1905.

The extent of development on this reservoir in 1959 compared to the other five, is shown by the following:

Type of Development	Number on: Winnibigoshish	Number on: All Reservoirs	Percent of Total
Resorts	16	411	3.9
Cottages	113	2416	4.8
Year Round	1	830	0.1

All but 38 miles of shoreline on this reservoir are currently in public holding.

E. RIVER DISCHARGES

The flow of the Mississippi River fluctuates widely as shown by the fact that the discharge at Mile 13.8 (Robert St. Bridge-St. Paul) has varied from a maximum daily value of 125,000 cfs. to a minimum daily discharge of 632 cfs. The average annual flow at this point in the period from 1892 to 1957, was 8540 cfs. (geometric mean). Similar average discharges for the months of February and August are 3260 cfs. and 6490 cfs., respectively. The minimum recorded monthly discharge for the month of February was 1300 cfs. in 1895. The corresponding value for the month of August was 864 cfs. recorded in 1934. The minimum recorded daily discharge during the month of February occurred in 1933 at a value of 1100 cfs., and for the month of August the corresponding value was 632 cfs. recorded in 1934. The discharge frequency distributions for this same station for the months of February and August and for the annual average, are shown in Figures 6, 7 and 8, of Vol. 1, Part 3, which is submitted with this statement. As shown by Figures 6 and 7, the monthly average flows exceeded 70% of the time during the month of February are 2540 cfs. and during the month of August, 4470 cfs. These values are significant in that they are approximately the basis of calculations on the possibility of the low flow augmentation which will be mentioned subsequently. The above values are corrected for the extraction of water for the Minneapolis-Saint Paul water supply pumpage in the period from 1938 to 1957. In other words, to the discharges recorded at St. Paul, the water consumption pumpage has been added in these later years.

From what has been stated previously concerning variations in flow and annual averages, it will be apparent that there is no shortage of water on a long-time average annual basis. The problem relates to distribution of this flow over years of low discharge and then only during certain months and days of those years when adverse river assimilation characteristics combined with low discharges, make flow augmentation imperative if desirable conditions are to be maintained downstream.

In reviewing the discharge record at St. Paul for the period from 1892 to 1957 it should be recalled that for most of this period (from 1892 to 1936), that a degree of low flow augmentation was necessarily practiced in the interest of navigation downstream. Had this method of operation of the reservoirs not been practiced, the flows during the summer months of July, August and September, would have been materially lower than the values shown. This fact makes calculations relative to the effect of low flow augmentation on river sanitation somewhat indefinite since there is no district base line to illustrate the before and after effects.

F. EFFECT OF DISCHARGE ON WATER QUALITY

The occurrence of low discharges during certain of the critical summer months of July, August and September and the winter months of December, January and February in a relatively few years makes it imperative that river discharges at St. Paul be augmented in the interest of stream sanitation. This applies both to the Mississippi River above the sewage treatment plant located at Pig's Eye Lake, as well as to the sections of the river below the plant in the Hastings Pool and below the confluence with the St. Croix River.

The recreational use and the aesthetic condition of the river in the stretch of the Mississippi River from St. Anthony Falls to the sewage treatment plant will be impaired unless low flow augmentation for stream sanitation is practiced. This would result from the fact that the sewers of the cities of Minneapolis and St. Paul are largely of the combined type, with periodic discharges of sewage necessarily occurring to the river during times of rainfall. When consideration is given to the fact that by the year 1980 the water supply usage by Minneapolis and St. Paul will approach the minimum river discharges at this point during the month of August, an extremely foul situation could be created in this 18-mile stretch of the Mississippi River under these conditions. Complete separation of the sewer systems is an economic impracticability, although a partial separation program is under way in both cities.

Of even greater significance is the condition of the Mississippi River below the sewage treatment works of the Sanitary District. This condition can be expressed in terms of dissolved oxygen content, bacteria, turbidity, temperature, etc. For purposes of this presentation, the dissolved oxygen criteria will be employed, since it is a good indicator of the effect of pollutional load on a river.

The five-year program of research conducted cooperatively by the Sanitary District and the Sanitary Engineering Division of the University of Minnesota, culminated in the preparation of a report previously mentioned and entitled "Pollution and Recovery Characteristics of the Mississippi River," Vol. 1, Part 3, dated September 1961. Particular attention is called to Section V of this report, beginning on page 99, and to Section VI, beginning on page 123. Section V entitled "River Capacity Investigations" presents information on the variables and the analysis conditions which were considered in the calculations of the river's capacity to receive and assimilate pollution. Section VI, entitled "Degree of

Treatment Requirements" shows the dissolved oxygen level which can be maintained under various river flow and other conditions.

The information which follows is based on the information contained in these two sections of the report. Table 1 herein corresponds to Table 54 in the report with certain additions. This table shows the percent of time that various degrees of treatment are necessary, and the maximum degree of treatment required during various critical river conditions. For the years 1965, 1980 and 2000 this table illustrates the critical nature of the months of August and February during which higher degrees of treatment are necessary for a greater percentage of the time. The growth effect of the metropolitan area is illustrated by the progressive higher requirements of treatment in 1980 and 2000, as compared to 1965. As stated earlier, the degree of treatment on which plans for plant enlargements are now being prepared, is based on a removal of BOD (biochemical oxygen demand) of 75 percent, with facilities to destroy more than 99.9% of the coliform organisms.

Item 3 of Table I, based on annual average conditions, illustrates the very small percentage of the time that treatment greater than a removal of 75% of the BOD is necessary. While under extreme conditions, even in 1965, a removal for a very short period of 90.2% would be required, the average time during the year that greater than 75% treatment is necessary is only 2-½%. This increases to 12.2% in the year 2000. A removal of 90% is as high as can be reasonably expected with any degree of certainty even with the best treatment now provided by conventional sewage treatment plants. This degree of treatment would be required less than 0.1 of 1% of the time in the year 1965, and up to only 0.8 of 1% of the time in the year 2000. Even this degree of treatment would not suffice for 100% of the time in 1980 and 2000, when maximum short-time degrees of treatment up to 94 and 95.5% respectively are indicated. As further shown in Item 3, the capacity in a plant beyond 75% treatment would essentially stand idle for more than 97-½% of the time based on 1965 conditions and more than 93% of the time based on 1980 conditions, to maintain the contemplated water quality objectives. As previously indicated, the above statements are based on river discharges which occurred in the past, during much of which low flow augmentation for navigation purposes was practiced.

The information contained in Table 1 is presented graphically in Figures 1 and 2. Referring to Figure 1, which is based on 1965 conditions, with a 9-foot channel, the lower portion of the graph, namely that below 75%, represents the work that will be done by the sewage treatment plant on an annual basis, or 75% of the total necessary.

The upper portion of the curve represents what natural purification in the river will provide, without flow augmentation other than was practiced in the past. This amounts to 24.8% of the total. The shaded portion of this graph represents the maximum degree of treatment, namely 90.2% and the duration of time that this treatment would be necessary, namely 2-½%. The shaded area represents the degree and the time for which treatment beyond 75% would be necessary and comprises only 0.2 of 1% of the total purification task or problem. It would be an economic impracticability to accomplish this by a major investment in plant facilities which would stand idle most of the time. Flow augmentation for relatively short periods of time is a much more reasonable solution from an engineering standpoint. The same type of information for the year 1980 is shown in Figure 2.

The previous graphs were on an average annual basis. Figure 3 shows the duration and the degree of treatment for conditions which are expected to prevail under August 1980 conditions. The upper line shows the conditions with no flow augmentation. They correspond to the information in Item 1, of Table 1 for the year 1980. The two lower lines in the shaded area show the effect of 500 and 1000 cfs. of flow augmentation on both the degree of treatment and duration of time that this treatment will be necessary. Table 2 and Figure 4 show similar information for the critical months of February and August on a 1980 and 2000 basis. The four graphs in this figure are enlargements of the shaded portion in the previous figures and show the very marked effect of flow augmentation on the duration and degree of treatment. Any flow augmentation both in amount and time beyond what is necessary to maintain the water quality objectives which are the basis of the calculations would, for the same degree of treatment, improve the quality of water downstream from the plant.

The points of zero flow augmentation in Figure 4 represent river discharges at St. Paul (including water supply pumpage) of the following amounts:

	February	August
Mean. Monthly Discharge exceeded 90% of Time	1760	2630
Mean. Monthly Discharge exceeded 90% of Time	820	760
Min. 5-Day Discharge exceeded 99% of Time	630	710

The estimated water pumpages from the Mississippi River and the net river flows at St. Paul available for effluent dilution are shown in Tables 51 and 52 of the report.

The effect of low flow augmentation on the treatment requirements can be shown in another way, for August 1980 conditions. By employing Figure 91 in the Part 3 report, it can be shown that a difference of 100 cfs. in flow at St. Paul affects the removal percentage required by 0.5%. Thus the degree of treatment increases 5% for every 1000 cfs. that the flow is reduced. A reduction from 4000 cfs. to 3000 cfs. would necessitate an increase in the degree of treatment from 75% to 80% to maintain the same water quality. The above applies to a minimum dissolved oxygen value of 2.0 ppm. The effect is somewhat greater at a level of 1.0 ppm, being approximately 6% for every 1000 cfs.

To illustrate the effect of flow augmentation on water quality expressed in terms of dissolved oxygen, Table 3 has been prepared from Figure 91. This table indicates that for every 1000 cfs. increase in flow the minimum dissolved oxygen level would increase 0.5 to 2.0 ppm (usually 1.0 to 1.5 ppm) depending somewhat on the amount of augmented flow, the degree of treatment and the dissolved oxygen level. The dissolved oxygen values downstream from the point of the minimum level would also be greater. This is a very significant increase, one which would be very expensive to provide by increased treatment or artificial river aeration because of the short duration requirements.

G. FLOW AUGMENTATION CONSIDERED NECESSARY AND PRACTICABLE

Previous Statements. At the January 22, 1931 hearing, the Metropolitan Drainage Commission suggested a desirable schedule of minimum flows for sanitation purposes (with sewage treatment works in operation) which provided for flows at St. Paul of 5500 cfs., in July and 4200 cfs. in August, and flows at Prescott of 4800 cfs. in January, February and March. Suggested minimum desirable flows during other months were considerably less. At the March 28, 1935 hearing, the Minneapolis-Saint Paul Sanitary District submitted a schedule of desirable low discharges with the suggestion of 5700 cfs. during the month of July and 4800 cfs. during the month of August, and with the same winter discharge at Prescott of 4800 cfs. The discharges at Prescott were stated in both statements because the section below the junction with the St. Croix River is critical from the standpoint of fish life. Since the minimum flows at Prescott during the month of February are approximately 2000 cfs. greater than corresponding flows at St. Paul, the value of 4800 at Prescott would correspond to a discharge at St. Paul approximately 2800 cfs. At the

January 16, 1945 hearing, the Sanitary District referring to earlier suggested values, stated: "It is possible that in the light of actual experience during the past 6 years of sewage treatment plant operation and a study of the effect of such operation on river conditions, that slightly lower values, particularly during the summer season, would be permissible." In the meantime, however, the Metropolitan Area has experienced a very rapid growth which has increased the treatment and effluent requirements.

The previous statements could be summarized to indicate a desirable minimum July and August flow at St. Paul between 4800 and 5200 cfs. and a desirable winter flow of at least 2800 cfs. (in the two statements where definite values were presented).

At a meeting held in the offices of the Minneapolis-Saint Paul Sanitary District in the winter of 1960, attended by representatives of the Army Engineer St. Paul District Office, the Division of Waters of the State of Minnesota, the Sanitary District's consulting engineers and engineers of the Sanitary District, a minimum discharge at St. Paul of 4500 cfs. during the critical summer months and of 2500 cfs. during the critical winter months, was suggested by the Chief Engineer of the Sanitary District as a basis of study by the District Engineer's Office. These values include the water supply diversions by Minneapolis and

Practical Flow Augmentation. At a hearing called by the Minnesota Water Pollution Control Commission and the Minnesota State Board of Health held on May 28, 1962, Colonel Strandberg, District Engineer of the St. Paul Office, submitted a statement from which the following is extracted:

> "On the subject of augmentation of the low river flows from the standpoint of the Corps of Engineers, it is considered proper to state that it is believed possible to augment low flows by releases from the headwaters reservoirs. .... Our Office made a preliminary study to determine if the three main reservoirs, namely, Winnibigoshish, Leech and Pine River Reservoirs, could have been operated to supply sufficient discharges to sustain flows at St. Paul of 4500 cfs. during the period July 1 to September 10, and 2500 cfs. during the period of December 15 to March 15th. This study covered the period 1931-1959, and indicated the following: In the 1930's there were a number of years the desired flows could not be sustained at the desired summer amounts, but could have provided the following:

"Year	Flow in Sec. Ft. at St. Paul (Incl. diversions)	
	Actual	With reservoir supplements
1931	1720	3170
1932	1670	3340
1933	1630	2050
1934	1010	1670
1935	3290	4500
1936	1280	2300
1937	3400	4500
1939	2980	4250
1940	2500	3830"

The study shows that in this 29-year period the winter flows of 2500 cfs. could have been maintained in all of the years from 1937 on, and during the summer months in 21 of the 29 years. Even during the extreme low water years of 1931 to 1936, the possible low flow augmentation varied from a minimum of 420 cfs. to a maximum of 1670 cfs., which occurred in 1933 and 1932 respectively.

With the reservation that the study was made from a hindsight point of view with full knowledge of the flow irregularities in the years ahead, the District Engineer concluded his letter of June 22, 1960 to the Chief Engineer of the Minneapolis-Saint Paul Sanitary District as follows:

"In conclusion, this brief study indicates that for the period 1931-1959, the summer and winter minimum total river flows at St. Paul of 4500 and 2500 cfs. respectively, could have been met with the assistance of the headwaters reservoirs except during the drought of the 1930's."

H. EFFECT OF DISCHARGE ON SEWAGE WORKS CONSTRUCTION AND ANNUAL COSTS

Certain of the beneficial effects of the installation of pollution abatement works, such as the reduction in possible health hazards and aesthetic considerations, while very important are intangible and impossible of monetary evaluation. In some cases these are the principal reasons for the construction of sewage treatment plants. In this statement only the tangible and calculable effects of low flow augmentation are presented, even though it is recognized that the intangible factors associated are of considerable importance.

While the previous statements and presentations concerning the effect of flow augmentation on the duration and degree of treatment required, were necessarily based on the pollutional load from the entire metropolitan area, whether served by the present or proposed enlarged plant, the estimates of costs which will be presented below are related only to the presently contracted area consisting of Minneapolis and St. Paul and 24 suburban communities. It is quite likely that the number of communities served will increase in the future.

The existing sewage treatment plant of the Minneapolis-Saint Paul Sanitary District provides for primary treatment by sedimentation augmented at times of low river discharge by chemical treatment. From the time the plant was placed in operation in 1938 to 1957 inclusive, river flows were favorable and satisfactory conditions could be maintained downstream without the necessity of chemical treatment. Beginning in 1958 low flows developed during critical summer and winter seasons and it was necessary to add chemicals for extended periods. Even with additions of $1200 per day of chemicals, water quality objectives could not be maintained downstream. In addition extra expenditures for sludge disposal were necessary. While recognizing that the plant was moderately overloaded, the experiences during the past several years pointed up the importance of river flow on costs of sewage treatment and water quality.

As stated, a sewage treatment plant of the high rate activated sludge type based for a BOD removal of 75 percent, is now under design. As previously shown, this degree of treatment will suffice for all but 2-½% of the time in 1965, and all but 6.9% of the time in 1980. However, for a few days' duration over a period of years removals as high as 90.2% in 1965 and 94% in 1980 would be required. If a conventional activated sludge plant capable of removing up to 90% of the BOD were installed, it would have to be utilized to full capacity less than 0.1 of 1% of the time in 1965, and less than 0.4 of 1% of the time in 1980. Even then, this plant would not be able to meet the maximum very short time removals of 94% required in 1980. The comparative costs of the two types of plants based on 1980 conditions are as follows:

	Removal of BOD of:	
	75%	90%
Total Construction Costs	$22,800,000	$38,700,000
Fixed Charges at 5.33%	1,216,000	2,064,000
Annual Operations and Maintenance Costs	2,677,000	3,108,000
Total Annual Charges	3,893,000	5,172,000

The additional investment of $15,900,000 would stand idle much of the time in the period from 1965 to 1980. The fixed charges on this investment over a 30-year period (the bond period) are estimated at $25,440,000.

Another way of evaluating the effect of low flow augmentation is as follows: The total annual charges per 100 pounds of BOD removal are estimated to be $3.01 for a plant designed for 75% removal and $3.32 for a plant which provides 90% BOD removal, an average of $3.17. It was shown previously that the degree of treatment would have to be increased 5% for every 1000 cfs of reduced flow. The 1980 estimated raw sewage BOD is estimated to amount to 470,000 pounds per day. For every 1000 cfs. of augmented flow a reduction of 23,500 pounds per day can be made in BOD removals necessary, or a saving of $750 per day that this level of augmentation is practiced. Greater augmentation will proportionately decrease the costs. Augmentation to a discharge of 4500 cfs. on the minimum monthly recorded flow of 864 cfs. at St. Paul would reduce the costs by approximately $2700 per day. It should be pointed out that these are not daily operation and maintenance costs, but include as well the fixed charges on the necessary investment.

TABLE 1

DURATION OF, AND MAXIMUM DEGREES OF SEWAGE TREATMENT REQUIRED

		Percent of Time Various Degrees of Treatment are Necessary				
Item	**Period**	Greater Than 75%	Greater Than 80%	Greater Than 85%	Greater Than 90%	Maximum Degree of Treatment, %
1.	August					
	1965	7.8	4.0	1.7	-	88.4
	1980	25.0	12.5	4.8	2.2	93.2
	2000	35.5	21.0	9.0	4.2	95.5
2.	February					
	1965	6.0	3.6	2.0	*	90.2
	1980	11.8	7.2	4.1	2.0	94.0
	2000	19.0	11.5	6.0	3.0	95.1
3.	Twelve Months					
	1965	2.5	1.0	0.35	*	90.2
	1980	6.9	3.4	0.8	0.4	94.0
	2000	12.2	6.2	2.4	0.8	95.5
4.	Dec-Jan-Feb.					
	1965	3.3	1.6	0.6	*	90.2
	1980	7.6	4.0	1.6	0.6	94.0
	2000	15.5	8.4	3.8	1.3	95.1
5.	July-Aug-Sept.					
	1965	4.8	2.1	0.7	-	88.4
	1980	14.3	6.9	2.5	0.8	93.2
	2000	21.8	11.7	4.5	1.6	95.5

* Less than 0.1 of 1% of time.

TABLE 2

DEGREES OF TREATMENT REQUIRED TO MEET STATED DISSOLVED OXYGEN LEVELS WITH FLOW AUGMENTATION

		No Flow Augmentation	Flow Augmentation -- Cfs.						
			500	1000	1500	2000	2500	3000	3500
A. In the Hastings Pool of the Mississippi River									
1. Two ppm of dissolved oxygen maintained 90 percent of time during critical months (1)									
February	1965	68	57	47					
	1980	76.1	67	60					
	2000	80.5	73.4	67					
August	1965	75.6	72	68					
	1980	82.9	80.4	78.0	75.4				
	2000	86.1	83.9	81.9	79.7	77.5	75.7		
2. One ppm of dissolved oxygen maintained during extreme minimum monthly discharges (2)									
February	1965	86.5	75.0	64					
	1980	90.7	81.4	72					
	2000	92.4	84.8	77.2					
August	1965	88.4	82.6	78.0					
	1980	92.7	88.5	84.6	81.2	78.4	75.9		
	2000	94.4	91.1	87.8	84.7	82.3	79.8	77.4	75.0

(1) Two ppm of dissolved oxygen maintained at mean monthly discharges exceeded 90 percent of the time during the critical months of February and August.

(2) One ppm of dissolved oxygen maintained at mean monthly discharges exceeded 99 percent of the time during the critical months of February and August.

TABLE 2 (continued)

DEGREES OF TREATMENT REQUIRED TO MEET STATED DISSOLVED OXYGEN LEVELS WITH FLOW AUGMENTATION

		No Flow Augmentation	Flow Augmentation -- Cfs.						
			500	1000	1500	2000	2500	3000	3500
A. In the Hastings Pool of the Mississippi River (Con't.									
3. A trace of dissolved oxygen maintained during extreme minimum 5-day discharge (3)									
February	1965	90.2	77.8	66					
	1980	94.0	84.0	74.0					
	2000	95.1	87.0	78.2	70				
August	1965	87.8	81.4	76.4					
	1980	93.2	88.0	83.5	79.8	76.8			
	2000	95.5	91.2	87.0	83.5	80.4	77.8	75.5	

(3) A trace of dissolved oxygen maintained during periods of minimum 5-day discharges exceeded 99 percent of the time during the critical months of February and August.

TABLE 3

EFFECT OF LOW FLOW AUGMENTATION ON THE MINIMUM DISSOLVED OXYGEN LEVEL FOR VARIOUS DEGREES OF TREATMENT: - August 1980 Conditions

	Degree of Treatment - %			
	75	80	85	90
Mean Monthly Discharge Exceeded 99% of Time, Cfs.*	* 430	430	430	430
Dissolved Oxygen, ppm. with Augmentation of: -				
500 cfs.	0	0	0	1.7
1000 cfs.	0	0	1.0	2.9
1500 cfs.	0	0.5	2.1	3.5
2000 cfs.	0	1.4	2.7	3.9
2500 cfs.	0.7	2.1	3.2	4.2 ±
3000 cfs.	1.5	2.6	3.5	4.4 ±
3500 cfs.	2.1	3.0	3.8	4.6 ±
4000 cfs.	2.5	3.3	4.1±	4.8 ±

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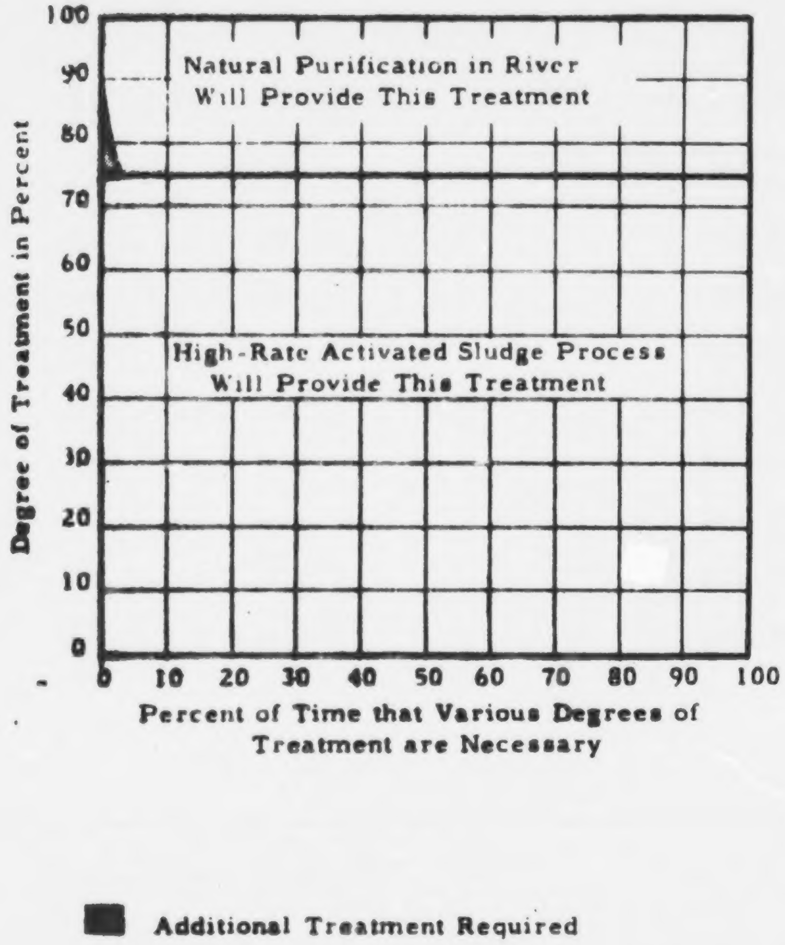
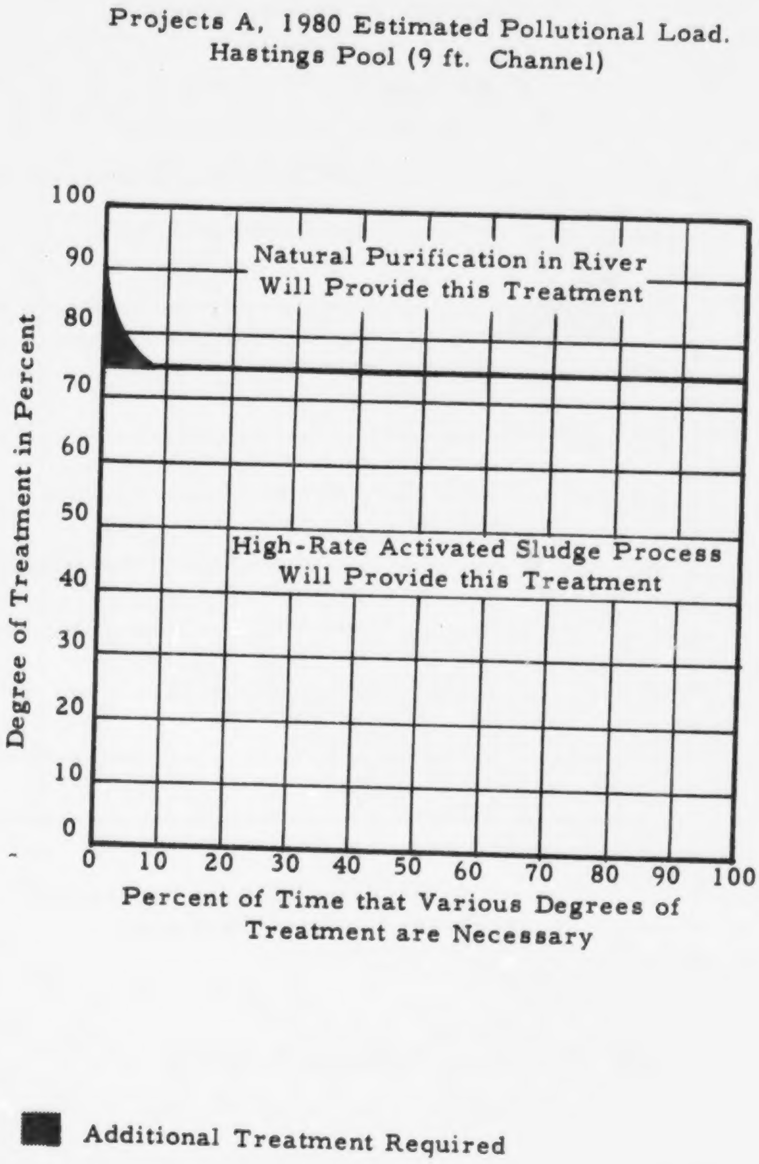
* Net Discharge, 760 - 330 (Water Supply Diversion)

Projects A, 1965 Estimated Pollutional Load.
Hastings Pool (9 ft. Channel)



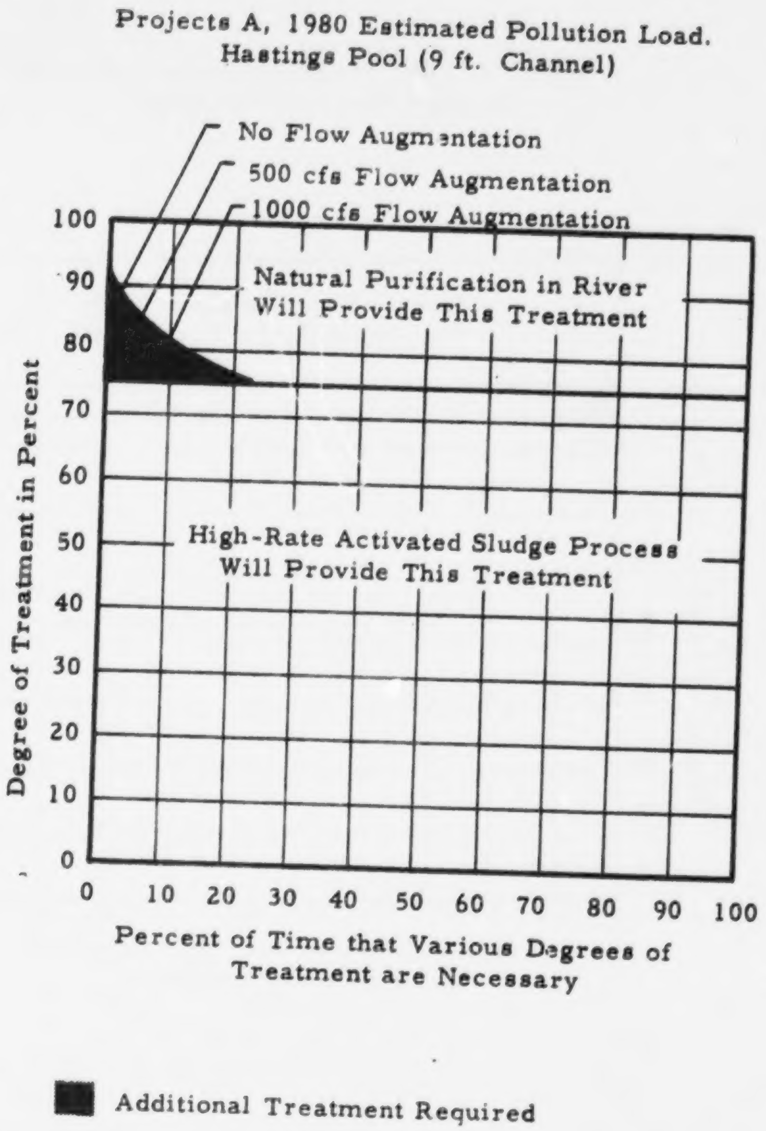
DURATION OF DEGREES OF TREATMENT IN EXCESS OF 75 PERCENT - Annual Basis, 1965

Figure 1



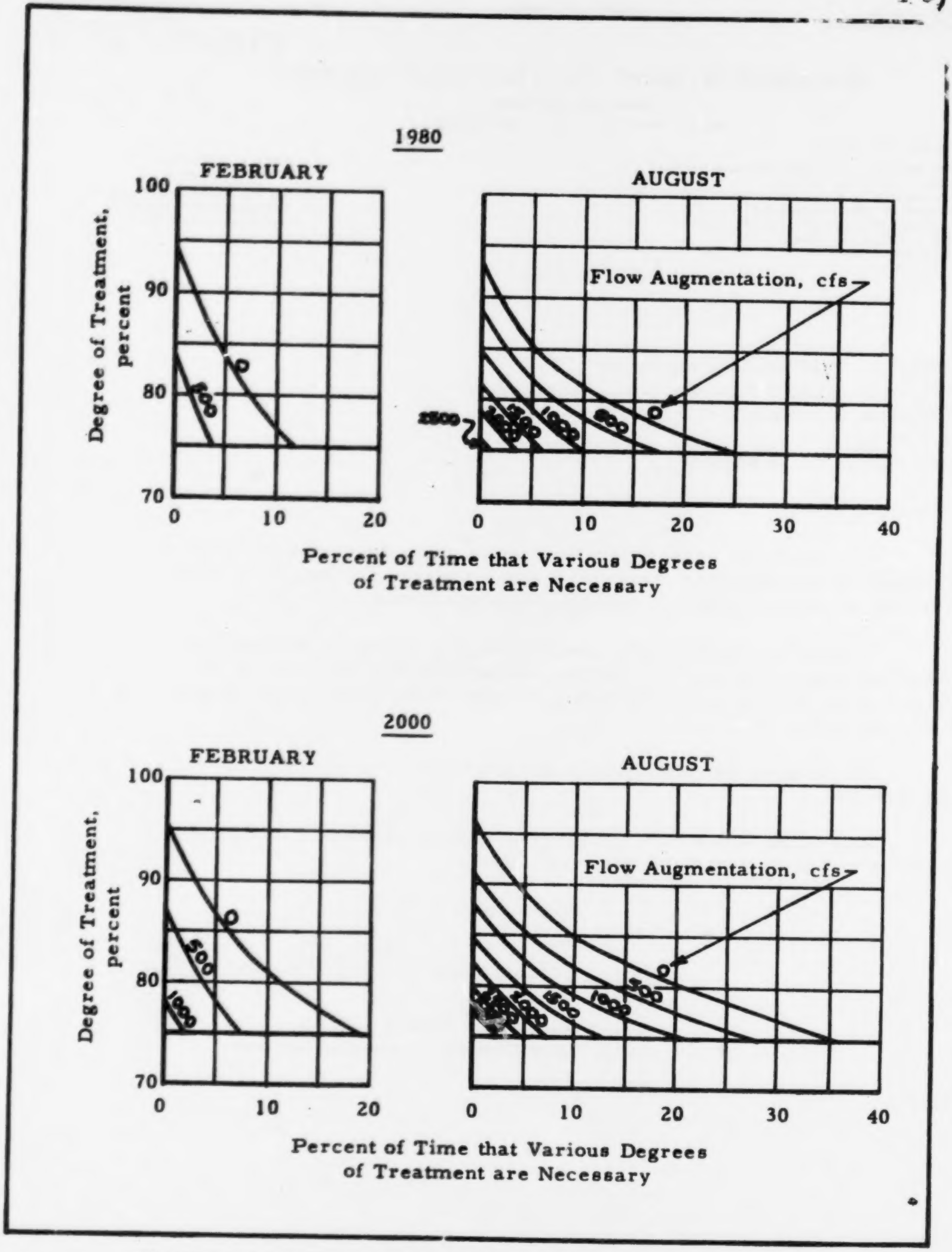
DURATION OF DEGREES OF TREATMENT IN EXCESS OF 75 PERCENT - Annual Basis, 1980

Figure 2



DURATION OF DEGREES OF TREATMENT IN EXCESS OF
75 PERCENT - August, 1980

Figure 3



EFFECT OF LOW FLOW AUGMENTATION ON THE DEGREE AND DURATION OF TREATMENT

Figure 4

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EXHIBIT "E"

KERWIN L. MICK
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MINNEAPOLIS - SAINT PAUL SANITARY DISTRICT
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ADDRESS ALL COMMUNICATIONS
TO THE SECRETARY UNLESS
OTHERWISE REQUESTED

July 19, 1962

Robert N. Barr, M.D., Secretary
Minnesota Water Pollution Control Commission
Minnesota State Board of Health
U of M Campus
Minneapolis 14, Minnesota

Gentlemen:

In order to assist the Commission in its study and evaluation of the proposed Mississippi River water quality standards for the third zone, the attached statement and factual analytical data are herewith presented.

Emphasis is made in this statement as to occurrences of minimum dissolved oxygen levels at key sampling stations and in a well defined stretch of the Mississippi River during the past twenty-year period, 1942-1961, inclusive.

All sampling data contained in this statement were collected under my direction.

Also included is a brief presentation of facts concerning pollutional loadings to this stretch of the Mississippi River.

Yours truly,

Maurice L. Robins

Maurice L. Robins
Chief Chemist & Sanitary Engineer

MLR:j

MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT

Statement for Presentation
At Hearing Of
Minnesota State Board of Health
Minnesota Water Pollution Control Commission

* * *

AN ANALYSIS OF RIVER QUALITY DATA
BELOW THE
MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT TREATMENT PLANT

JULY 19, 1962

* * *

Introduction

While data on river quality has been collected and published for a 100-mile stretch of the Mississippi River for a period of more than 35 years (for the past 29 years by the Minneapolis-Saint Paul Sanitary District), the detailed information is distributed among many reports and volumes. To assist the Commission and others interested in the consideration of this data in connection with the proposed quality standards for the stretch of the Mississippi River from the outfall of the existing Minneapolis-Saint Paul Sanitary District (MSSD) treatment plant to a point immediately above the confluence with the St. Croix River below Hastings, a compilation of dissolved oxygen (DO) conditions for the twenty-year period (1942-1961) and for a 38-mile stretch of the river has been prepared. This data is presented as Appendices A through F to this statement. To be of further assistance this data has been analyzed and summarized in a series of tabulations and charts the presentation of which is the principal subject of this statement.

General

The MSSD sewage treatment plant has been in operation since July, 1938. The South St. Paul (SSP) sewage treatment plant began its operations in August, 1941. Inasmuch as the effluent discharges from both of these treatment plants materially affect DO conditions in the Mississippi River, this analysis of the river water sampling data commences with the 1942 calendar year even though the data in the attached Appendices A through F begin with 1938.

The analytical data contained in the frequency tabulations, charts, and appendices of this statement have been summarized from a total of 8,918 river water samples collected during the aforementioned twenty-year period.

These samples were collected in the 38-mile stretch of the Mississippi and St. Croix Rivers from M 18.0, one mile below the MSSD effluent discharge, to M 56.1 at the Red Wing Lock and Dam.

Conditions At Sampling Station M 39.1

Tables 1, 2 and 3 indicate the twenty-year frequency of occurrence of DO values in the Mississippi River at sampling station M 39.1, Hastings Highway Bridge, during the low flow-ice cover winter period of January-February-March, the low flow-high water temperature summer period of July-August-September, and the annual observations, respectively.

Table 1 shows that of the 1,805 days comprising the twenty winter periods under discussion, none of these indicate DO values less than one ppm; 56 days, or 3.1% of the time, evidence values of less than two ppm; and only on 140 days, or 7.8% of the time, were the DO levels less than three ppm. It is apparent from Table 1 that 90 of the 140 days occurred during the past three years when DO concentrations in the Mississippi River were aggravated by unfavorable river flows and overloaded conditions at the MSSD sewage treatment plant.

In Table 2 the DO frequencies for the twenty summer periods, totaling 1,840 days, reveal that at no time during these summer periods was the DO level less than three ppm. Moreover, values of less than four ppm are indicated on only six days, 0.3% of the time, with five of these occurring during 1961.

On an annual observation basis a total of 7,305 days are involved in the course of the twenty-year period. The data of Table 3 indicate that at no time was the DO level below one ppm and that for only 0.8% of the time (56 days) was a DO value of less than two ppm obtained. Furthermore, on only 145 days or 2.0% of the time were values of less than three ppm obtained.

Conditions At Sampling Stations M 56.1

Tables 4, 5 and 6 contain the data concerning the Mississippi River at sampling station M 56.1, immediately above the Red Wing Lock and Dam, for the same winter, summer, and yearly periods as for stations M 39.1. These tabulations indicate that unfavorable DO conditions did not exist in this section of the Mississippi River from 1942 through 1961. Whereas only 0.8% or 14 days of the 1,805 days of the January-February-March winter periods (Table 4) indicate DO values of less than four ppm with none less than three ppm, the 1,840 days of the July-August-September summer periods (Table 5) contain no observed DO values less than four ppm. The Table 5 summer data also show that 98.6% of the 1,840 days indicate DO values greater than five ppm. The annual data of Table 6 yields the information that at this sampling station, M 56.1, DO levels were greater than four ppm for 99.8% of the time; greater than five ppm for 98.1% of the time; with no observed DO values of less than three ppm.

Conditions At Sampling Station M 41.7

Tables 7, 8 and 9 present similar DO data with respect to the St. Croix River at sampling station M 41.7, immediately above its confluence with the Mississippi River at Prescott, Wisconsin. Data included in these tabulations show the DO level at this station always above two ppm with only 4 days or 0.1% of the time (these occurring during the July-August-September periods) indicating values of less than three ppm. Values of greater than four ppm are indicated for 99.7% of the time on an annual basis.

Conditions in The Hastings Pool (M 18.0-M 37.8)

Table 10 summarizes the dissolved oxygen frequency data for the Hastings pool stretch of the

Mississippi River between stations M 18.0 and M 37.8 at the Hastings Lock and Dam. This tabulation indicates frequency of occurrence during any one year from 1942 through 1961 for those DO values less than one and two ppm. Although DO values in recent years, 1958 through 1961, of less than one ppm were observed between 12.0% and 32.9% of the time, and those of less than two ppm between 23.8% and 42.5% of the time, the average values for the entire twenty-year period were less than 1 ppm for only 5.0% of the time and less than 2 ppm for 8.7% of the time. The increase in occurrence of lower DO levels in recent years in this stretch of the Hastings pool can be attributed in a large measure to unfavorable river flows and increased pollution loads in the effluent discharges from the MSSD sewage treatment plant, the SSP sewage treatment plant, and other municipal and industrial installations above and below these plants.

Simultaneous Occurrence

Appendices A through F contain the river sampling data showing the minimum DO values at either M 39.1, M 41.7, or M 56.1, as base or comparison stations, during the January-February-March and July-August-September periods and compares these values with samples obtained on the same or nearest day at other stations between M 39.1

and M 56.1. Also included are average river flow data during these periods as well as the minimum DO values obtained in the Hastings Pool on the same or nearest days as those of the base station. The minimum DO value for each year at each of the base stations was then plotted as Chart I along with the DO values obtained at the other two base stations on the same or nearest day for both the January-February-March and July-August-September periods. Also plotted are the minimum observed values in the Hastings Pool stretch of the river on the same or nearest sampling day.

Chart I indicates the following:

A) M 56.1 as base station

Period	Minimum DO Observed ppm	DO On Same or Nearest Day At: M 39.1	M41.7	Minimum DO In Hastings Pool On Same or Nearest Day
Jan-Feb-March	3.20 (1959)	1.80	10.60	0.20
July-Aug-Sept.	4.15 (1959)	4.05	8.20	0.25

B) M 39.1 as base station

Period	Minimum DO Observed ppm	DO On Same or Nearest Day At M 41.7	M 56.1	Minimum DO In Hastings Pool On Same or Nearest Day
Jan-Feb-March	1.30 (1959)	10.90	4.40	0.00
July-Aug-Sept.	3.40 (1961)	8.55	4.30	0.10

C) M 41.7 as base station

Period	Minimum DO Observed ppm	DO On Same or Nearest Day At M 39.1	M56.1	Minimum DO In Hastings Pool On Same or Nearest Day
Jan-Feb-March	8.00 (1943)	9.05	7.70	7.00
July-Aug-Sept.	2.90 (1955)	5.50	--	2.00

The relationships shown in Chart I indicate that although unfavorable DO conditions of less than one and two ppm have existed at times in the Hastings pool stretch of the Mississippi River from 1942 through 1961, the river recovery characteristics have resulted in no less than three ppm being observed in the fourteen mile stretch from the confluence with the St. Croix River to Station M 56.1 at the Red Wing Lock and Dam.

Variations Along The Length Of The Hastings Pool

Where minimum DO concentrations are reported in Appendices A through F for the Hastings pool stretch of the river, this data is not meant to infer that these minimum values were prevalent over the entire stretch of the Hastings pool. The majority of these minimum occurrences were observed at one of several but not necessarily the same sampling station in an approximate eleven-mile stretch of the pool extending from M 26.5, four miles below Inver Grove, to M 37.8 at the Hastings Lock and Dam.

A percentage of time value for the dissolved oxygen comparisons was used in preference to a percentage of samples collected because during periods of unfavorable dissolved oxygen observances the practice is to sample the critical stretches of the river at a greater than normal frequency.

Past and Future Pollutional Load

As previously mentioned in this statement the effluent discharges from both the MSSD and SSP sewage treatment plants materially influence DO conditions in the Mississippi River, especially during periods of low river flows. Calculations of the pounds per day of biochemical oxygen demand (BOD) in both the raw sewage and effluents from these plants, as presented in Table 11, indicate trends in the pollutional loads since 1942. The figures of Table 11 show that although the pounds per day of raw sewage BOD load increased 82% from 1942 to 1961, the effluent BOD increased approximately 110%. A graphical presentation of the total raw sewage and effluent BOD loading trends is shown on Chart II.

Estimated 1965 and 1980 BOD loadings have also been calculated based on 75% removal of BOD in the discharges from the MSSD and other plants downstream. These values are shown in Table 11 and on Chart II and indicate that a 75% BOD reduction in 1965 will produce a total daily effluent load comparable to those discharged from 1942 to 1946, inclusive. For the same 75% reduction in BOD the estimated daily loading to the Mississippi River in 1980 would be less than previously discharged during the past seven years.

Relative to the MSSD treatment plant, Table 11 (Column 3) shows that based on 1965 conditions with the expanded plant in operation the effluent is estimated to contain approximately 90,000 pounds of BOD per day compared to about 200,000 pounds in the last several years. Ever since 1942 the load on the river from this plant has been greater than 100,000 pounds. Even in 1980 the estimated load on the river from the MSSD effluent will be only 2/3 of the present load on a pound basis. In addition, the effluent from the expanded plant will be much more stable, as far as rate of decomposition is concerned, than the present effluent.

Summary

This analysis of the Mississippi and St. Croix Rivers, along with the other pertinent data, has been presented in this concise form in order that it may be of immediate benefit and assistance to those concerned with the task of establishing equitable water quality standards in this stretch of the Mississippi River above the confluence with the St. Croix River.

References:

(1) MSSD - "Mississippi River Analytical Data," annual publication, 1942-1961, inclusive.

(2) "Report On The Expansion of Sewage Works In The Minneapolis-Saint Paul Metropolitan Area," Volume 3 - Part 1, Toltz, King, Duvall, Anderson, and Associates, Report to MSSD.

(3) South St. Paul Sewage Treatment Plant Annual Reports, 1942-1946, inclusive.

Table 1

Frequency of Occurrence of Dissolved Oxygen at Sampling Station M 39.1, January - February - March

Year	Number of Days Dissolved Oxygen was less than Dissolved Oxygen, ppm																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1942							0	12	21	29	72	84	90					
1943						0	3	42	85	90								
1944										0	14	79	90	91				
1945									0	19	78	89	90					
1946				0	24	42	52	58	74	76	87	90						
1947							0	27	63	79	81	86	90					
1948			0	8	35	49	44	62	64	81	89	91						
1949		0	14	36	41	54	58	65	71	76	80	90						
1950			0	2	34	64	74	79	86	88	90							
1951							0	24	55	80	90							
1952								0	6	31	53	91						
1953							0	13	32	72	81	90						
1954									0	25	39	56	90					
1955				0	21	32	36	53	60	75	80	90						
1956	0	8	36	59	74	84	87	90	91									
1957					0	11	21	40	59	68	84	90						
1958							0	14	41	54	63	82	90					
1959	0	38	65	70	73	74	75	76	77	78	79	80	81	82	83	84	88	90
1960	0	2	12	33	46	61	74	81	83	90	91							
1961	0	8	13	21	37	48	58	65	78	85	90							
Total	0	56	140	229	385	519	582	801	1046	1287	1522	1730	1795	1797	1798	1799	1803	1805
% of Time	0	3.1	7.8	12.7	21.3	28.8	32.2	44.4	58.0	71.3	84.3	95.8	99.4	99.6	99.6	99.7	99.9	100

Table 2

Frequency of Occurrence of Dissolved Oxygen at Sampling Station M 39.1, July - August - September

Year	Number of Days Dissolved Oxygen was less than Dissolved Oxygen, ppm											
	1	2	3	4	5	6	7	8	9	10	11	12
1942					0	10	73	83	92			
1943				0	32	58	70	80	84	92		
1944				0	1	39	63	83	87	92		
1945					0	4	49	79	92			
1946					0	16	45	63	80	92		
1947			0	1	7	18	52	74	82	86	92	
1948					0	7	31	64	87	89	92	
1949					0	6	30	61	91	92		
1950							4	49	81	92		
1951					0	28	55	85	92			
1952					0	21	56	81	87	92		
1953				0	0	39	70	75	92			
1954				0	2	34	51	82	90	92		
1955				0	9	48	83	92				
1956				0	17	39	71	86	92			
1957				0	26	37	44	69	92			
1958				0	[illegible]	17	29	66	90	92		
1959				0	18	49	61	84	92			
1960				0	7	43	70	79	92			
1961			0	5	29	55	66	83	86	89	91	92
Total	0	0	0	6	151	568	1073	1518	1773	1828	1839	1840
% of Time	0	0	0	0.3	8.2	30.9	58.3	82.5	96.4	99.3	99.9	100

Table 3

Frequency of Occurrence of Dissolved Oxygen at Sampling Station M 39.1, Annual Basis

Year	Number of Days Dissolved Oxygen Was Less Than Dissolved Oxygen, ppm																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1942					0	20	108	159	206	252	284	340	365					
1943				0	32	67	95	161	232	280	309	314	325	363	365			
1944				0	1	45	98	129	145	204	250	329	365	366				
1945					0	4	65	105	153	213	331	360	365					
1946				0	24	68	137	157	212	270	314	342	365					
1947			0	1	7	18	67	134	236	300	360	365						
1948			0	8	35	56	101	172	255	301	333	365	366					
1949		0	14	36	41	60	105	167	221	295	324	356	365					
1950			0	2	34	65	88	172	244	269	306	341	365					
1951					0	33	63	117	203	244	276	316	337	361	365			
1952					0	26	78	134	161	202	282	365	366					
1953					0	46	100	134	209	245	277	355	365					
1954				0	2	43	69	112	149	199	262	326	365					
1955				0	30	88	185	225	298	323	347	365						
1956	0	8	36	59	94	140	188	228	271	290	333	350	356	366				
1957				0	26	62	90	157	216	258	277	319	363	365				
1958		0	5	12	21	44	93	171	266	303	321	351	365					
1959	0	38	65	70	93	130	176	217	273	310	318	326	333	338	344	349	358	365
1960	0	2	12	33	52	115	191	239	293	350	364	366						
1961	0	8	13	35	80	123	162	215	283	323	351	365						
Total	0	56	145	256	572	1253	2259	3305	4526	5431	6219	6916	7192	7272	7284	7289	7298	7305
% of Time	0	0.8	2.0	3.5	7.8	17.2	30.9	45.2	62.0	74.3	85.1	94.7	98.5	99.5	99.7	99.8	99.9	100

Table 4

Frequency of Occurrence of Dissolved Oxygen at Sampling Station M 56.1, January - February - March

Number of Days Dissolved Oxygen Was Less Than Dissolved Oxygen, ppm																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
							0	14	26	72	84	89	90						
						0	6	85	90										
									0	13	79	88	91						
								0	36	73	90								
				0	23	43	50	64	81	90									
						0	2	28	77	81	86	90							
			0	2	14	33	50	69	91										
			0	24	34	43	53	66	77	79	87	90							
				0	34	62	73	84	90										
					0	27	75	90											
								0	50	91									
						0	9	54	72	88	90								
								0	23	43	62	90							
					0	18	50	60	72	90									
			0	54	67	80	91												
						0	12	45	59	72	90								
							0	18	43	64	74	89	90						
		0	14	31	38	62	67	70	74	77	78	79	80	81	82	84	86	88	90
				0	13	33	57	75	81	84	91								
					0	3	22	34	49	89	90								
0	0	0	14	111	223	404	617	947	1272	1558	1724	1789	1795	1796	1797	1799	1801	1803	1805
0	0	0	0.8	6.1	12.4	22.4	34.2	52.5	70.5	86.3	95.5	99.1	99.4	99.5	99.6	99.7	99.8	99.9	100

Table 5

Frequency of Occurrence of Dissolved Oxygen at Sampling Station M 56.1, July - August - September

	Number of Days Dissolved Oxygen Was Less Than										
	Dissolved Oxygen, ppm										
Year	1	2	3	4	5	6	7	8	9	10	11
1942					0	12	81	84	92		
1943				0	14	55	68	83	87	92	
1944					0	52	76	87	92		
1945					0	23	59	92			
1946					0	32	51	79	92		
1947					0	19	60	84	92		
1948					0	4	10	17	51	81	92
1949						0	55	77	92		
1950						0	47	81	87	92	
1951					0	38	59	89	92		
1952					0	36	67	82	91	92	
1953					0	41	80	92			
1954				0	9	25	79	88	92		
1955					0	45	84	92			
1956					0	12	51	85	92		
1957					0	29	62	82	90	92	
1958					0	15	40	86	92		
1959					0	20	52	82	91	92	
1960					0	9	52	65	80	90	92
1961				0	3	12	41	75	77	85	92
Total	0	0	0	0	26	479	1174	1602	1758	1820	1840
% of Time	0	0	0	0	1.4	26.0	63.8	87.1	95.5	98.9	100

Table 6

Frequency of Occurrence of Dissolved Oxygen at Sampling Station M 56.1, Annual Basis

	Number of Days Dissolved Oxygen Was Less Than Dissolved Oxygen, ppm																			
ear	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
942					0	16	112	140	186	224	291	350	365							
943				0	14	65	96	124	245	282	313	318	333	365						
944					0	71	113	138	164	216	251	344	366							
945					0	23	75	115	162	233	326	365								
946					0	61	111	164	211	287	331	357	365							
947					0	19	65	125	204	293	339	361	365							
948				0	2	18	53	90	187	273	331	366								
949				0	24	34	137	184	236	291	332	357	365							
950					0	34	109	191	223	264	328	365								
951					0	38	100	186	234	283	300	343	365							
952					0	36	71	100	174	224	300	354	365							
953					0	44	103	146	219	253	326	365								
954				0	9	35	95	109	155	199	243	322	365							
955					0	45	106	191	242	304	357	365								
956				0	54	87	153	209	247	284	321	341	352	366						
957					0	29	76	147	202	241	272	330	357	364	365					
958					0	15	69	147	209	275	314	335	362	365						
959			0	14	31	58	137	197	242	260	283	317	329	335	337	340	348	356	361	365
960					0	22	120	170	232	299	328	360	366							
961				0	3	18	55	116	186	243	319	338	365							
otal	0	0	0	14	137	768	1956	2989	4160	5228	6205	6953	7212	7274	7277	7280	7288	7296	7301	7305
% of ime	0	0	0	0.2	1.9	10.5	26.8	40.9	56.9	71.6	84.9	95.2	98.7	99.6	99.6	99.7	99.8	99.9	99.9	100

Table 7

Frequency of Occurrence of Dissolved Oxygen at Sampling Station M 41.7,
January - February - March

	Number of Days Dissolved Oxygen Was Less Than														
	Dissolved Oxygen, ppm														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1942										0	18	71	90		
1943								0	45	66	90				
1944										0	4	41	91		
1945									0	40	52	78	90		
1946									0	52	71	87	90		
1947									0	45	66	89	90		
1948								0	24	38	64	91			
1949								0	17	44	58	70	90		
1950								0	31	41	56	90			
1951								0	55	67	79	90			
1952								0	22	69	76	87	91		
1953								0	9	39	58	80	90		
1954									0	17	55	84	90		
1955									0	32	49	75	90		
1956								0	65	78	89	91			
1957								0	20	41	65	80	90		
1958									0	10	31	59	89	90	
1959										0	48	79	90		
1960									0	18	64	85	91		
1961										0	12	24	65	87	90
Total	0	0	0	0	0	0	0	0	288	697	1105	1541	1779	1802	1805
% of Time	0	0	0	0	0	0	0	0	16.0	38.6	61.2	85.4	98.6	99.8	100

Table 8

Frequency of Occurrence of Dissolved Oxygen at Sampling Station M 41.7,
July - August - September

Year	Number of Days Dissolved Oxygen Was Less Than Dissolved Oxygen, ppm 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1942					0	9	82	92						
1943					0	48	89	92						
1944				0	32	64	90	92						
1945					0	30	90	92						
1946				0	43	60	71	92						
1947					0	11	31	57	80	92				
1948						0	10	40	72	84	87	91	92	
1949					0	61	92							
1950						0	61	77	80	83	85	88	90	92
1951				0	18	41	72	92						
1952				0	26	61	80	91	92					
1953				0	13	67	91	92						
1954				0	7	56	88	92						
1955		0	4	20	31	43	60	79	92					
1956						0	16	66	83	88	92			
1957				0	5	65	87	92						
1958				0	4	29	49	86	92					
1959						0	30	80	92					
1960				0	7	17	20	51	63	85	92			
1961						0	21	47	74	85	92			
Total	0	0	4	20	186	662	1230	1594	1740	1805	1828	1835	1838	1840
% of Time	0	0	0.2	1.1	10.1	36.0	66.8	86.6	94.6	98.1	99.3	99.7	99.9	100

Table 9

Frequency of Occurrence of Dissolved Oxygen at Sampling Station M 41.7, Annual Basis

Year	Number of Days Dissolved Oxygen Was Less Than Dissolved Oxygen, ppm 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1942					0	22	114	148	185	204	248	339	365		
1943					0	48	109	151	217	278	321	336	365		
1944				0	32	66	124	152	190	219	241	305	366		
1945					0	30	93	128	148	247	289	327	365		
1946				0	43	67	87	126	170	252	307	335	365		
1947					0	11	31	85	150	246	285	342	365		
1948						0	31	103	196	252	313	352	366		
1949					0	75	146	168	212	259	305	345	365		
1950						0	70	127	197	229	270	342	363	365	
1951				0	18	41	72	120	215	262	293	321	357	365	
1952				0	26	61	80	114	185	275	300	332	364	366	
1953				0	13	71	111	134	158	227	282	333	365		
1954				0	7	59	96	111	143	183	246	327	365		
1955		0	4	20	31	43	70	117	169	240	279	324	365		
1956						0	16	96	235	267	321	345	366		
1957				0	5	65	87	128	174	244	298	325	365		
1958				0	4	29	49	130	151	193	243	303	362	365	
1959						0	43	121	155	180	237	281	364	365	
1960				0	16	33	43	105	131	222	305	336	346	353	366
1961						0	29	78	143	182	218	264	332	361	365
Total	0	0	4	20	195	721	1501	2442	3534	4666	5601	6514	7236	7288	7305
% of Time	0	0	0.1	0.3	2.7	9.9	20.5	33.4	48.4	63.9	76.7	89.2	99.1	99.8	100

Table 10

Frequency of Occurrence of Dissolved Oxygen Values Below Two ppm in Hastings Pool (M 18.0 - M 37.8)

Year	Total No. of Days - DO Below 2 ppm	Total No. of Days - DO Below 1 ppm	Percent of Time - DO less than 2 ppm	Percent of Time - DO less than 1 ppm
1942	0	0	0	0
1943	0	0	0	0
1944	0	0	0	0
1945	0	0	0	0
1946	0	0	0	0
1947	8	1	2.2	0.3
1948	28	0	7.7	0
1949	43	4	11.8	1.1
1950	0	0	0	0
1951	0	0	0	0
1952	0	0	0	0
1953	0	0	0	0
1954	7	0	1.9	0
1955	26	2	7.1	0.5
1956	38	10	10.4	2.7
1957	0	0	0	0
1958	101	65	27.7	17.8
1959	144	116	39.5	31.8
1960	87	44	23.8	12.0
1961	155	120	42.5	32.9
1942-61 Average	32	18	8.7	5.0

Table 11

Average Daily 5-Day 20°C BOD (lbs/day) Of Raw Sewage And Effluents From Minneapolis-Saint Paul Sanitary District And South St. Paul Treatment Plants

	Minneapolis-St. Paul Sanitary District		South St. Paul[a]		Total	
Year	Raw Sewage	Effluent	Raw Sewage	Effluent	Raw Sewage	Effluent
1942	167990	100800	57000	17100	224990	117900
1943	176030	104300	82815	41830	258845	146130
1944	178350	107000	72490	21530	250840	128530
1945	187930	118600	66670	14400	254600	133000
1946	198990	114300	62870	8300	261860	122800
1947	209500	125600	70200	19800	279700	145400
1948	204830	122800	74440	23080	279270	145880
1949	202960	119700	90140	26220	293100	145920
1950	214200	133600	85180	26070	299380	159670
1951	202410	120800	96320	22190	298730	142990
1952	193940	116000	90750	27660	284690	143660
1953	223585	140000	87250	31530	310835	171530
1954	244990	153600	80900	27730	325890	181330
1955	271400	175070	105340	42570	376740	217640
1956	288200	184220	85030	30290	373230	214510
1957	284300	175030	99650	40170	383950	215200
1958	283200	184020	84900	35260	368100	219280
1959	293400	191010	100870	31300	394270	222310
1960	307000	209520	102300	33620	409300	243140
1961	307550	208390	101460	40360	409010	248750
1965[b]	361800[c]	90450[c]	133200[d]	33300[d]	495000	123750
1980[b]	560520[c]	140130[c]	207360[d]	51840[d]	767880	191970

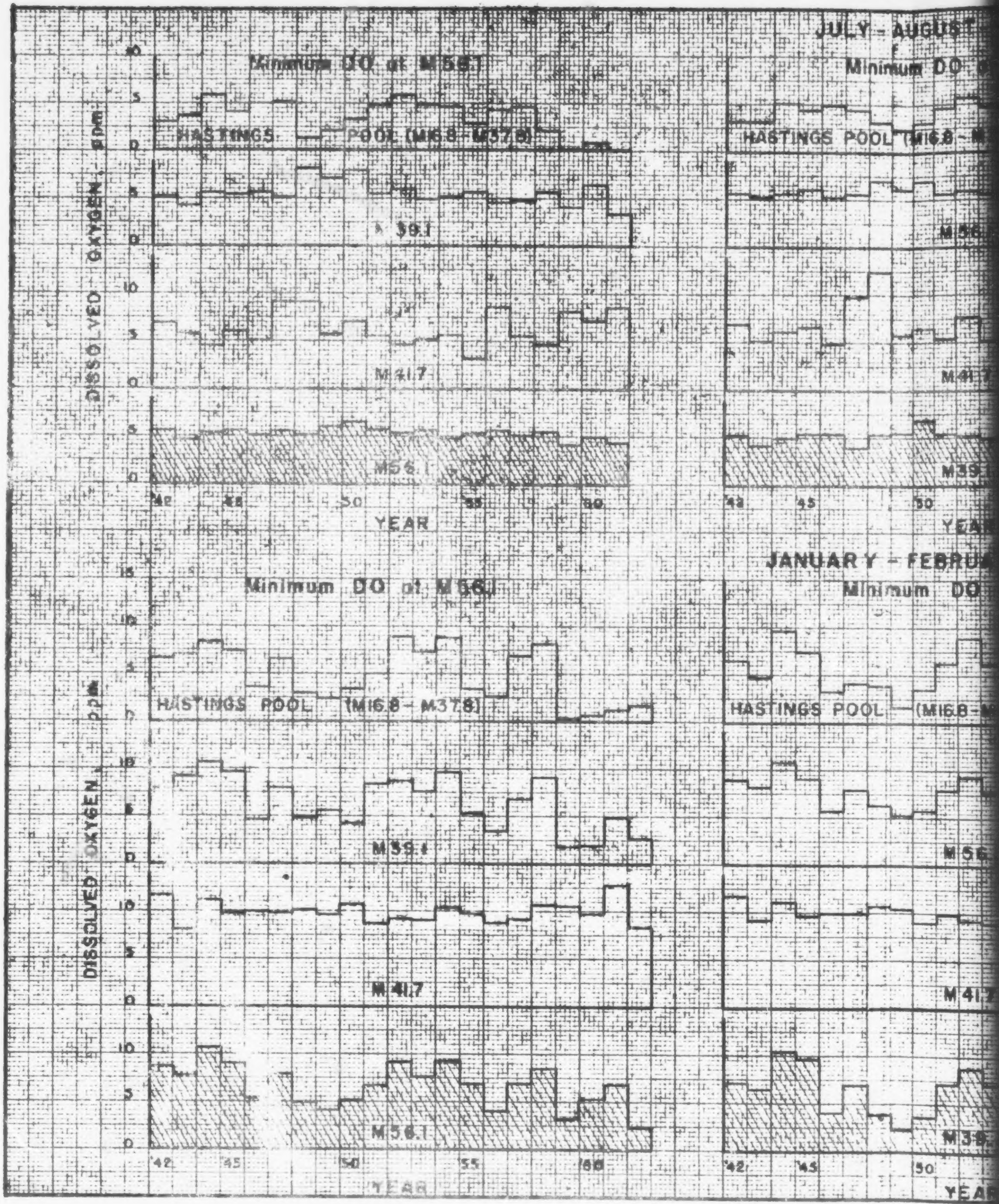
(a) Values for South St. Paul are for the fiscal year April 1 - March 31 and have been used for that calendar year corresponding to the beginning of each fiscal year.

(b) 1965 and 1980 estimates are based on 75% BOD reduction at conditions of Sewage Works Project A, as presented in "Report on the Expansion of Sewage Works in the Minneapolis-Saint Paul Metropolitan Area, Volume 3 - Part 1."

(c) These values are the estimated pollutional load from the expanded Metropolitan Area, as presented in Volume 3 - Part 1.

(d) These values include the entire Southeast Region.

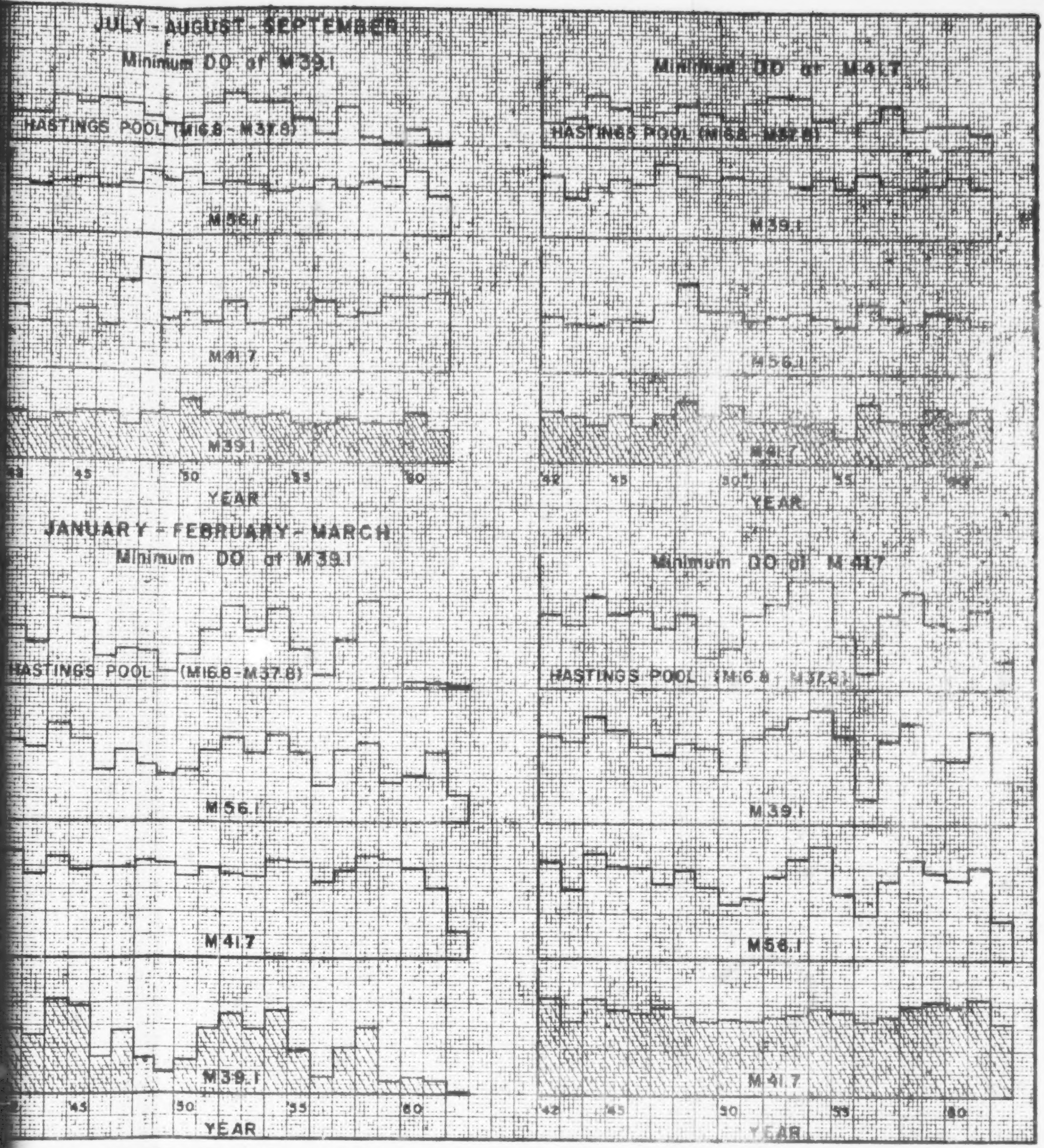
CHART I



RELATIONSHIP BETWEEN MINIMUM DISSOLVED OXYGEN VALUES AT O
OXYGEN VALUES AT OTHER STATIONS DURING CRITICAL

A

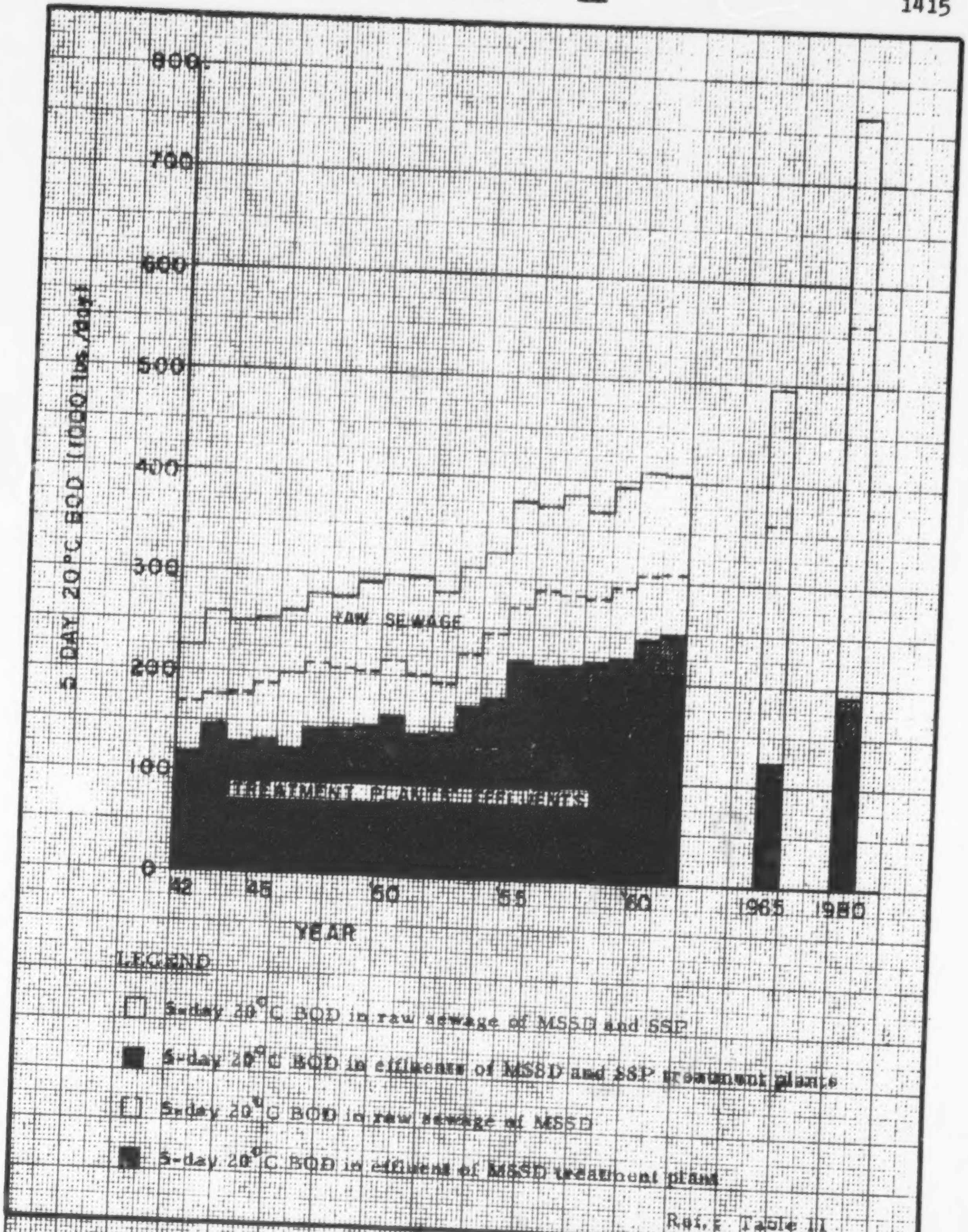
CHART I



XYGEN VALUES AT ONE STATION AND CORRESPONDING DISSOLVED
NS DURING CRITICAL SUMMER AND WINTER PERIODS (1942 - 62)

B

CHART II



AVERAGE DAILY 5-DAY 20°C BOD RAW SEWAGE AND EFFLUENTS FROM MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT AND SOUTH ST. PAUL TREATMENT PLANTS

K&E 10 X 10 TO THE CM. 359-14

Appendix A to F

JANUARY - FEBRUARY - MARCH COMPARATIVE DISSOLVED OXYGEN VALUES IN THE MISSISSIPPI AND ST. CROIX RIVERS USING MINIMUM DISSOLVED OXYGEN VALUES AT SAMPLING STATION M 39.1 AS A BASE

Year	Date	Minimum DO at M 39.1	Corresponding DO Values on Same Date				Low DO Values in Hastings Pool			Discharge, cfs**			Remarks	No. of Samples Represented
			M 37.8	M 41.7*	M 52.5	M 56.1	DO	Date	Station	M 13.8	M 41.7	M 42.8		
1942	1/21	7.00	7.20(1)	11.70	8.00	8.80	6.50	1/22	M 30.5	4640	3000	7640	(1)1/22	1942 - 22
1943	2/4	6.50	4.80	9.30(2)	7.75(2)	8.10(2)	4.80	2/4	M 37.8	5440	3230	8670	(2)2/2	1943 - 20
1944	3/21	10.40	9.70	11.10(3)	11.00(3)	10.70(3)	9.70	3/21	M 37.8	9460	3590	13050	(3)3/22	1944 - 21
1945	2/13	9.60	8.80	9.80	9.70	9.00(4)	7.40	2/13	M 30.5	6440	3620	10060	(4)2/14	1945 - 12
	2/20	9.60	8.90	9.60	9.40	9.60(5)	8.10	2/20	M 30.5	6440	3620	10060	(5)2/19	
1946	2/13	4.00	3.30	9.90	5.70	5.60	3.30	2/13	M 37.8	4340	3850	8190		1946 - 13
	2/19	4.00	3.50	9.90	5.60	5.50	3.50	2/19	M 37.8	4340	3850	8190		
	2/7	4.70	4.00	10.00(6)	5.55(6)	5.35(6)	4.00	2/7	M 37.8	4340	3850	8190	(6)2/5	
1947	2/13	7.00	6.70	9.90	8.10	7.90	4.20	2/13	M 30.5	5670	3570	9240		1947 - 12
1948	2/4	3.90	4.10	10.70	6.20	6.25	3.95	2/3	M 30.5	4210	2860	7070		1948 - 15
	1/27	4.00	5.50	11.00	6.80	5.90	4.40	1/28	M 30.5	3950	4080	7030		
	2/10	4.00	3.80	10.50	5.40	5.10	3.65	2/11	M 30.5	4210	2860	7070		
	2/19	4.50	4.20	10.35	6.40	6.95	4.20	2/19	M 37.8	4210	2860	7070		
	2/6	4.80	4.40	10.70(7)	6.20(7)	6.25(7)	3.05	2/6	M 30.5	4210	2860	7070	(7)2/4	
	2/17	4.80	2.90	10.20	4.80	4.90	2.90	2/17	M 37.8	4210	2860	7070		
	2/25	4.80	4.40	9.70	6.30	6.15	4.40	2/24	M 37.8	4210	2860	7070		
1949	2/8	2.20	1.60	10.40	5.40(8)	5.20(8)	1.60	2/8	M 37.8	3630	2320	5950	(8)2/2	1949 - 14
	2/1	2.80	3.70	11.00	5.40(8)	5.20(8)	3.70	2/1	M 37.8	3630	2320	5950		
	1/18	2.95	3.70	12.60	8.10(9)	8.70(9)	3.70	1/18	M 37.8	3431	2145	5576	(9)1/11	
	1/20	3.10	3.40	11.80	6.40(10)	6.20(10)	3.40	1/20	M 37.8	3431	2145	5576	(10)1/27	
	1/26	3.30	3.60	11.70	6.40(10)	6.20(10)	3.60	1/26	M 37.8	3431	2145	5576		
	1/12	3.70	4.30	12.40	8.10(9)	8.70(9)	4.30	1/12	M 37.8	3431	2145	5576		
	2/16	3.90	2.20	10.00	4.30(11)	4.30(11)	2.20	2/16	M 37.8	3630	2320	5950	(11)2/15	
	3/1	4.70	3.50	9.20	5.50(12)	5.60(12)	3.50	3/1	M 37.8	12130	3820	15950	(22)3/3	
1950	2/28	3.70	3.50	9.00	5.40(13)	5.70(13)	3.50	2/28	M 37.8	3660	2980	6640	(13)3/1	1950 - 13
	2/8	4.30	3.40	10.70	5.30(14)	5.10(14)	3.40	2/8	M 37.8	3660	2980	6640	(14)2/7	
	1/24	4.60	3.90	11.90(15)	5.10(16)	6.60	3.90	1/24	M 37.8	4050	2130	6180	(15)1/25 (16)2/1	

* St. Croix River

** Mean Monthly Discharge; M 13.8 - Miss. R. flow at Robert St. plus MSSD flow; M 42.8 - Miss. R. flow measured downstream of confluence with St. Croix R.; M 41.7 - St. Croix R. (difference between M 13.8 and M 42.8)

APPENDIX - A
(Cont'd)

JANUARY - FEBRUARY - MARCH COMPARATIVE IDSSOLVED OXYGEN VALUES IN THE MISSISSIPPI AND ST. CROIX RIVERS USING MINIMUM DISSOLVED OXYGEN VALUES AT SAMPLING STATION M 39.1 AS A BASE

Year	Date	Minimum DO at M 39.1	Corresponding DO Values on Same Date				Low DO Values in Hastings Pool			Discharge, cfs**			Remarks	No. of Samples Represented
			M 37.8	M 41.7*	M 52.5	M 56.1	DO	Date	Station	M 13.8	M 41.7	M 42.8		
1951	1/23	7.25	6.25	9.90	8.90	7.90	6.25	1/23	M 37.8	5070	2820	7890		1951 - 8
1952	2/14	8.80	8.90	9.30	10.10	9.30(17)	8.90	2/14	M 37.8	7910	4910	12820	(17)2/13	1952 - 11
1953	3/10	7.05	6.20	9.00	7.20	7.70(18)	6.20	3/10	M 37.8	14020	6880	20900	(18)3/3	1953 - 9
1954	2/2	9.20	8.60	10.80	9.75(19)	9.65(19)	8.60	2/2	M 37.8	6710	4150	10860	(19)1/26	1954 - 13
1955	2/17	4.60	4.05	10.60	5.85	7.70(20)	4.05	2/17	M 37.8	4190	3210	7400	(20)2/16	1955 - 13
	2/23	4.65	3.10	10.20	6.00	7.70(20)	3.10	2/23	M 37.8	4190	3210	7400		
	3/9	4.65	3.25	9.40	5.50	7.25(21)	3.25	3/9	M 37.8	7900	4700	12600	(21)3/15	
1956	2/15	1.80	1.30	8.40	3.50	4.00(22)	1.30	2/15	M 37.8	3170	3600	6770	(22)2/16	1956 - 13
	2/29	2.00	1.40	8.15	4.30	4.90(23)	1.40	2/29	M 37.8	3170	3600	6770	(23)2/28	
	2/21	2.05	1.75	8.50	4.60	4.00(22)	1.75	2/21	M 37.8	3170	3600	6770		
	2/7	2.65	2.40	8.50	4.10	4.00(24)	2.40	2/7	M 37.8	3170	3600	6770	(24)1/31	
	1/25	2.80	2.00	9.15	4.60	4.00(24)	2.00	1/25	M 37.8	3480	3750	7230		
	3/7	2.80	1.80	8.10	5.00	5.00(25)	1.80	3/7	M 37.8	4140	3780	7920	(25)3/14	
	2/1	3.45	2.55	8.75	4.20	4.00(24)	2.55	2/1	M 37.8	3170	3600	6770		
	3/13	3.55	3.35	8.05	4.95	5.00(25)	3.35	3/13	M 37.8	4140	3780	7920		
	1/17	4.15	2.25	9.60	4.60	5.45(26)	2.25	1/17	M 37.8	3480	3750	7230	(26)1/18	
	1/11	4.35	3.40	10.20	6.35	5.45(26)	3.40	1/11	M 37.8	3480	3750	7230		
1957	2/20	5.00	5.20	9.70	6.70	8.00	5.20	2/20	M 37.8	2760	2770	5530		1957 - 7
1958	2/18	7.25	7.10	11.35	8.15	8.70	7.10	2/18	M 37.8	4860	3050	7910		1958 - 19
1959	2/26	1.30	0.00	10.90	4.85	4.40(27)	0.00	2/26	M 30.5, M 37.8	1980	2320	4300	(27)2/25	1959 - 14
	2/11	1.75	0.25	10.50	4.75	3.70(28)	0.25	2/11	M 37.8	1980	2320	4300	(28)2/10	
	2/17	1.80	0.20	10.60	4.70	3.20	0.20	2/17	M 37.8	1980	2320	4300		
	3/3	1.80	0.15	10.65	5.70	4.65	0.15	3/3	M 37.8	3120	3080	6200		
	1/28	1.95	0.70	11.25	5.80	10.45(29)	0.70	1/28	M 37.8	2250	2230	4480	(29)1/27	
	1/6	2.00	1.00	12.35	5.65	6.95	1.00	1/6	M 37.8	2250	2230	4480		
	2/3	2.00	0.25	10.60	4.95	5.00	0.25	2/3	M 37.8	1980	2320	4300		
	1/20	2.30	0.40	11.60	5.35	6.45	0.40	1/20	M 37.8	2250	2230	4480		
	3/10	2.30	1.00	11.90	5.80	5.70(30)	0.30	3/10	M 30.5	3120	3080	6200	(30)3/11	
	1/14	2.60	0.95	11.70	6.55	6.65(31)	0.95	1/14	M 37.8	2250	2230	4480	(31)1/13	
	1/8	3.20	2.00	12.35(32)	5.65(32)	6.95(43)	2.00	1/8	M 37.8	2250	2230	4480	(32)1/6	

APPENDIX - A
(Cont'd)

JANUARY - FEBRUARY - MARCH COMPARATIVE DISSOLVED OXYGEN VALUES IN THE MISSISSIPPI AND ST. CROIX RIVERS USING MINIMUM DISSOLVED OXYGEN VALUES AT SAMPLING STATION M 39.1 AS A BASE

Year	Date	Minimum DO at M 39.1	Corresponding DO Values on Same Date				Low DO Values in Hastings Pool			Discharge, cfs**			Remarks	No. of Samples Represented
			M 37.8	M 41.7*	M 52.5	M 56.1	DO	Date	Station	M 13.8	M 41.7	M 42.8		
1960	3/16	1.85	0.65	9.85	5.35	5.30(33)	0.65	3/16	M 37.8	4410	2560	6970	(33)3/15	1960 - 13
	2/24	3.05	2.30	9.95	5.80	6.45	2.30	2/24	M 37.8	3680	2510	6190		
	3/8	3.15	1.95	10.30	5.20	5.55	1.95	3/8	M 37.8	4410	2560	6970		
	3/22	3.35	3.55	10.05	6.90	7.30	3.35	3/22	M 39.1	4410	2560	6970		
	3/2	3.45	2.10	9.95	6.65	6.50(34)	2.10	3/2	M 37.8	4410	2560	6970	(34)3/1	
	2/3	4.10	2.20	10.55	7.25	6.90(35)	2.20	2/3	M 37.8	3680	2510	6190	(35)2/2	
	2/18	4.50	4.25	10.30	5.80(36)	7.80(37)	4.25	2/18	M 37.8	3680	2510	6190	(36)2/24 (37)2/16	
1961	2/15	1.40	0.40	12.40	7.80	7.85	0.40	2/15	M 37.8					
	2/21	1.80	0.40	12.80	6.95	6.80	0.40	2/21	M 37.8					1961 - 12
	1/17	3.70	3.40	13.20	8.65	10.10	3.40	1/17	M 37.8					
	2/28	4.40	3.20	12.80	7.90	8.75	3.20	2/28	M 37.8					
	2/7	4.85	1.25	12.70	6.60	6.70	1.25	2/7	M 37.8					

JANUARY - FEBRUARY - MARCH COMPARATIVE DISSOLVED OXYGEN VALUES IN THE MISSISSIPPI AND ST. CROIX RIVERS USING MINIMUM DISSOLVED OXYGEN VALUES AT SAMPLING STATION M 41.7 AS A BASE

Year	Date	Minimum DO at M 41.7*	Corresponding DO Values on Same Date				Low DO Values in Hastings Pool			Discharge, cfs**			Remarks	No. of Samples Represented
			M 37.8	M 39.1	M 52.5	M 56.1	DO	Date	Station	M 13.8	M 41.7	M 42.8		
1942	2/18	10.60	9.70	9.70	10.70	10.70	8.20	2/19	M 30.5	5310	2780	8090		1942 - 11
1943	3/3	8.00	7.00(1)	9.05(1)	7.90	7.70	7.00	3/5	M 37.8	8810	4500	13310	(1)3/5	1943 - 11
1944	3/30	10.60	11.00(2)	11.80(2)	12.20	11.70	10.20	3/29	M 30.5	9460	3590	13050	(2)3/29	1944 - 22
1945	3/8	9.30	9.90	10.40	10.10	10.30(3)	8.10	3/8	M 30.5	26160	14530	40690	(3)3/7	1945 - 12
1946	3/14	9.00	8.60	8.50	8.80	10.20(4)	8.60	3/14	M 37.8	23760	11190	34950	(4)3/19	1946 - 13
1947	2/18	9.70	6.70	7.60	8.35	8.40	6.70	2/18	M 37.8	5669	3571	9240		1947 - 12
1948	3/24	8.55	8.60	9.00	8.60	9.80(5)	8.60	3/24	M 37.8	16870	5330	22200	(5)3/25	1948 - 14
1949	3/8	8.10	4.80	8.45	7.80(6)	8.00(6)	3.50	3/8	M 30.5	12130	3820	15950	(6)3/9	1949 - 14
1950	3/22	8.25	4.55	5.95	5.70(7)	6.10(7)	4.55	3/22	M 37.8	6670	4670	11340	(7)3/21	1950 - 12
1951	3/8	8.20	8.10	9.50	7.85(8)	6.70(8)	8.10	3/8	M 37.8	6830	3860	10690	(8)2/27	1951 - 8
1952	2/28	8.60	9.50	10.75	9.70	9.30(9)	9.50	2/28	M 37.8	7910	4910	12820	(9)2/13	1952 - 12
1953	3/25	8.80	12.00	11.90	10.30	11.30(10)	12.00	3/25	M 37.8	14020	6880	20900	(10)3/31	1953 - 9
1954	3/2	9.60	12.25	12.75	11.30	12.55(11)	12.00	3/2	M 18.0, M 22.7	11980	4650	16630	(11)3/9	1954 - 13
1955	3/16	9.15	5.90	9.90	9.25	7.25(12)	5.90	3/16	M 37.8	7900	4700	12600	(12)3/15	1955 - 13
1956	3/7	8.10	1.80	2.80	5.00	5.00(13)	1.80	3/7	M 37.8	4140	3780	7920	(13)3/14	1956 - 13
	3/22	8.10	3.90	5.00	5.10	7.30(14)	3.90	3/22	M 37.8	4140	3780	7920	(14)3/29	
1957	3/21	8.75	9.80	9.35	7.90	8.80	8.25	3/19	M 30.5	7260	4640	11900		1957 - 7
1958	3/18	9.90	10.95	11.35	10.85	11.10	10.80	3/18	M 30.5	8000	4540	12540		1958 - 11
1959	3/17	10.35	7.20	7.40	9.80	9.85	7.20	3/17	M 30.5, M 37.8	3120	3080	6200		1959 - 13
1960	3/30	9.70	7.15	7.35	7.55	8.85(15)	6.80	3/30	M 30.5	4400	2520	6970	(15)3/30	1960 - 13
1961	3/28	10.60	10.30	10.40	9.90	10.30	8.80	3/29	M 30.5					1961 - 11

*St. Croix River

**Mean Monthly Discharge: M 13.8 - Miss. R. flow at Robert St. plus MSSD flow; M 42.8 - Miss. R. flow measured downstream of confluence with St. Croix R.; M 41.7 - St. Croix R. flow (difference between M 13.8 and M 42.8)

APPENDIX - C

JANUARY - FEBRUARY - MARCH COMPARATIVE DISSOLVED OXYGEN VALUES IN THE MISSISSIPPI AND ST. CROIX RIVERS USING MINIMUM DISSOLVED OXYGEN VALUES AT SAMPLING STATION M 56.1 AS A BASE

Year	Date	Minimum DO at M 56.1	Corresponding DO Values on Same Date M 37.8	M 39.1	M 41.7*	M 52.5	Low DO Values in Hastings Pool DO	Date	Station	Discharge, cfs** M 13.8	M 41.7	M 42.8	Remarks	No. of Samples Represented
1942	1/15	8.60	7.40	7.90	11.70	8.80	6.70	1/14	M 30.5	4640	3000	7640		1942 - 11
1943	3/3	7.70	7.00(1)	9.05(1)	8.00	7.90	7.00	3/5	M 37.8	8810	4500	13310	(1)3/5	1943 - 10
1944	3/14	10.70	8.30(2)	10.70(3)	11.30	10.90	8.30	3/16	M 37.8	9460	3590	13050	(2)3/16 (3)3/15	1944 - 11
1945	2/14	9.00	8.00(4)	9.60(4)	9.80(4)	9.70(4)	7.40	2/13	M 30.5	6440	3620	10060	(4)2/13	1945 - 12
1946	2/5	5.35	3.50	4.70(5)	10.00	5.55	3.50	2/5	M 37.8	4340	3850	8190	(5)2/7	1946 - 12
1947	2/26	7.80	7.50	8.00	9.80	7.70	6.50	2/25	M 30.5	5670	3570	9240		1947 - 11
1948	2/17	4.90	2.90	4.80	10.20	4.80	2.90	2/17	M 37.8	4210	2860	7070		1948 - 15
1949	2/23	4.10	2.40(6)	5.60(6)	9.70(6)	4.30	2.40	2/24	M 37.8	3630	2320	5950	(6)2/24	1949 - 9
	2/15	4.30	2.20(7)	3.90(7)	10.00(7)	4.30	2.20	2/16	M 37.8	3630	2320	5950	(7)2/16	
1950	2/7	5.10	3.40(8)	4.30(8)	10.70(8)	5.30	3.40	2/8	M 37.8	3660	2980	6640	(8)2/8	1950 - 9
1951	2/27	6.70	6.40	8.40	8.60	7.85	5.00	2/21	M 30.5	4930	3010	7940		1951 - 5
1952	2/13	9.30	8.90(9)	8.80(9)	9.30(9)	10.10(9)	8.90	2/14	M 37.8	7910	4910	12820	(9)2/14	1952 - 6
1953	3/3	7.70	7.35(10)	7.55(10)	9.20(10)	7.90(10)	7.35	3/4	M 37.8	14020	6880	20900	(10)3/4	1953 - 5
1954	2/10	9.45	8.75(11)	9.75(11)	10.30(11)	9.50(11)	8.75	2/9	M 37.8	6710	4150	10860	(11)2/9	1954 - 6
1955	3/2	6.85	3.40(12)	5.15(12)	9.80(12)	6.30(12)	3.40	3/1	M 37.8	7900	4700	12600	(12)3/1	1955 - 7
1956	1/31	4.00	2.55(13)	3.45(13)	8.75(13)	4.20(13)	2.55	2/1	M 37.8	3480	3750	7230	(13)2/1	1956 - 7
	2/16	4.00	1.30(14)	1.80(14)	8.40(14)	3.50(14)	1.30	2/15	M 37.8	3170	3600	6770	(14)2/15	
	2/28	4.90	1.40(15)	2.00(15)	8.15(15)	4.30(15)	1.40	2/29	M 37.8	3170	3600	6770	(15)2/29	
1957	2/26	7.00	6.90	6.90	9.20	6.60	6.90	2/26	M 37.8	2760	2770	5530		1957 - 7
1958	3/4	8.50	8.05	9.10	10.75	9.05	8.05	3/4	M 37.8	8000	4540	12540		1958 - 12
1959	2/17	3.20	0.20	1.80	10.60	4.70	0.20	2/17	M 37.8	1980	2320	4300		1959 - 13
	2/10	3.70	0.40	1.75(16)	10.50(16)	4.75(16)	0.40	2/10	M 37.8	1980	2320	4300	(16)2/11	
	2/25	4.40	0.35	1.30(17)	10.90(17)	4.85(17)	0.00	2/26	M 30.5	1980	2320	4300	(17)2/26	
	3/3	4.65	0.15	1.80	10.65	5.70	0.15	3/3	M 37.8	3120	3080	6200		
1960	3/15	5.30	0.65(18)	1.85(18)	9.85(18)	5.35(18)	0.65	3/16	M 37.8	4400	2570	6970	(18)3/16	1960 - 13
1961	2/7	6.70	1.25	4.85	12.70	6.60	1.25	2/7	M 37.8					1961 - 11

* St. Croix River

** Mean Monthly Discharge: M 13.8 - Miss. R. flow at Robert St. plus MSSD flow; M 24.8 - Miss. R. flow measured downstream of confluence with St. Croix R.; M 41.7 - St. Croix R. flow (difference between , M 13.8 and M 42.8)

APPENDIX - D

JULY - AUGUST - SEPTEMBER COMPARATIVE DISSOLVED OXYGEN VALUES IN THE MISSISSIPPI AND ST. CROIX RIVERS USING MINIMUM DISSOLVED OXYGEN VALUES AT SAMPLING STATION M 39.1 AS A BASE

Year	Date	Minimum DO at M 39.1	Corresponding DO Values on Same Date				Low DO Values in Hastings Pool			Discharge, cfs**			Remarks	No. of Samples Represented
			M 37.8	M 41.7*	M 52.5	M 56.1	DO	Date	Station	M 13.8	M 41.7	M 42.8		
1942	7/16	5.20	5.30	6.90	5.50	5.60	3.15	7/14	M 22.7	9820	6600	15420		
1943	7/27	4.20	3.50(1)	5.10	5.40	5.40	3.15	7/28	M 33.9	22890	8900	31790	(1)7/28	1942 - 11
	7/15	4.35	4.35(2)	5.85	4.90	4.60	3.70	7/14	M 30.5	22890	8900	31790	(2)7/14	1943 - 12
	8/11	4.50	5.15(3)	5.80	5.20	4.90	4.50	8/9	M 26.5	13460	5400	18860	(3)8/9	
	7/22	4.70	4.90(4)	5.50	5.40	----	4.10	7/20	M 30.5	22890	8900	31790	(4)7/20	
1944	8/16	4.90	5.10	6.20	5.50	5.50	5.10	8/16	M 37.8	14590	5450	20040		
1945	7/27	5.45	7.15(5)	6.55	6.80	6.20	4.30	7/24	M 26.5	11860	7490	19350	(5)7/24	1944 - 12
	8/1	5.45	4.50(6)	6.05	5.90	5.70	4.20	8/2	M 33.9	10050	5800	15850	(6)8/2	1945 - 9
1946	7/17	5.40	5.40	4.90	5.45	5.35	4.95	7/16	M 30.5	19590	11690	31280		
1947	7/17	3.90	4.70	9.80(7)	5.00	5.60	4.40	7/14	M 26.5	18990	3520	22510	(7)Super Saturated 124.8%	1946 - 12
1948	8/19	5.40	5.30	12.45(8)	6.20	7.00(9)	3.20	8/19	M 30.5	6070	2620	8690	(8) 8/18	1947 - 13
1949	9/7	5.50	5.00	5.70	5.90	6.10	2.30	9/7	M 22.7	4800	2100	6900	(9) Super Saturated 152.7%	1948 - 11
1950	8/29	6.80	5.50	6.50	7.10	6.90(10)	3.10	8/31	M 26.5, M 30.5	6480	3160	9640	(10)8/30	1949 - 10
1951	7/26	5.40	5.60	5.30	5.10	5.70(11)	4.60	7/25	M 30.5	21710	12620	34330	(11)7/19	1950 - 11
1952	7/2	5.30	5.80	7.70	5.95	5.95(12)	5.70	7/1	M 30.5	30830	18140	48970	(12)7/10	1951 - 10
1953	7/21	4.95	5.00	5.10	5.45	5.65(13)	4.85	7/22	M 30.5	28750	10460	39210	(13)7/23	1952 - 13
1954	7/14	5.10	5.15	5.55	6.25(14)	4.85(15)	4.75	7/13	M 33.9	15680	13510	28190	(14)7/21 (15)7/15	1953 - 11
1955	8/4	4.05	3.50	6.70	5.00	5.15(16)	2.80	8/4	M 30.5	9900	9100	19000	(16)8/18	1954 - 11
1956	7/19	4.05	3.25	7.85	5.90	6.20(17)	1.05	7/19	M 26.5	17790	3920	11710	(17)7/26	1955 - 10
	8/9	4.55	5.50	8.55	5.00	5.55(18)	4.30	8/7	M 33.9	12600	4960	17560	(18)8/8	1956 - 11
1957	7/16	4.60	4.60	5.90	5.00	----	4.15	7/18	M 33.9	36830	11390	48220		
	7/24	4.60	4.60	5.50	4.90	5.15(19)	4.60	7/24	M 37.8	36830	11390	48220	(19)7/25	1957 - 9
	7/31	4.70	4.30	5.30	4.65	6.05(20)	4.30	7/31	M 37.8	36830	11390	48220	(20)8/7	
	7/11	4.80	4.80	6.10	4.90	----	4.80	7/11	M 37.8	36830	11390	48220		
1958	7/22	4.35	3.60	6.45	5.15	5.90	0.75	7/23	M 26.5	6031	9509	15540		
1959	8/27	4.05	3.35	8.20	4.15	5.40(21)	0.25	8/27	M 22.7	3304	3019	6323	(21)8/25	1958 - 11
	9/1	4.10	3.10	8.60	5.40	5.85	0.50	9/1	M 22.7	5269	4408	9677		1959 - 12
1960	7/12	5.25	5.25	8.20	5.65	7.05	1.70	7/13	M 26.5	8003	3397	11400		
1961	8/1	3.40	2.20	8.55	4.30	4.30	0.10	8/1	M 20.5, M 22.7					1960 - 11
	8/29	4.15	2.65	7.90	5.40	6.25	0.00	8/29	M 22.7					1961 - 10

* St. Croix River

** Mean Monthly Discharge: M 13.8 - Miss. R. flow at Robert St. plus MSSD flow; M 42.8 - Miss. R. flow measured downstream at confluence with St. Croix R.; M 41.7 - St. Croix River flow (difference between M 13.8 and M 42.8)

APPENDIX - E

JULY - AUGUST - SEPTEMBER COMPARATIVE DISSOLVED OXYGEN VALUES IN THE MISSISSIPPI AND ST. CROIX RIVERS USING MINIMUM DISSOLVED OXYGEN VALUES AT SAMPLING STATION M 41.7 AS A BASE

Year	Date	Minimum DO at M 41.7*	Corresponding DO Values on Same Date				Low DO Values in Hastings Pool			Discharge, cfs**			Remarks	No. of Samples Represented
			M 37.8	M 39.1	M 52.5	M 56.1	DO	Date	Station	M 13.8	M 41.7	M 42.8		
1942	7/23	5.60	4.75(1)	6.70	6.20	6.10	2.70	7/21	M 26.5	9820	5600	15420	(1)7/21	1942 - 11
1943	4/47	5.10	3.50(2)	4.20	5.40	5.40	3.15	7/28	M 33.9	22890	8900	31790	(2)7/28	1943 - 12
1944	7/20	4.10	6.10	5.50	5.10	5.30	5.70	7/19	M 30.5	27960	11920	39880		1944 - 11
	8/3	4.40	6.10	6.60	5.90	6.00	4.60	8/1	M 30.5	14590	6450	20040		
	7/11	4.50	5.95(3)	5.70(3)	5.30	5.30	5.90	7/13	M 26.5	27960	11920	39880	(3)7/13	
	7/28	4.60	6.00	6.60	5.40	5.70(4)	4.30	7/27	M 30.5	27960	11920	39880	(4)7/26	
1945	8/17	5.40	5.80(5)	6.40	6.10	5.90	4.25	8/10	M 30.5	10050	5800	15850	(5)8/10	1945 - 9
1946	8/1	4.10	6.10	6.00	5.65	5.85	3.50	7/31	M 26.5	5630	3510	9140		1946 - 12
	8/14	4.40	6.80	7.20	6.40	7.20(6)	4.40	8/12	M 30.5	5630	3510	9140	(6)8/15	
	8/7	4.60	6.40	6.85	5.75	6.45	3.50	8/6	M 26.5	5630	3510	9140		
	7/17	4.90	5.40	5.40	5.45	5.35	4.95	7/16	M 30.5	19590	11790	31280		
1947	9/17	5.40	7.70	8.10	7.50	7.60	3.90	9/17	M 30.5	5220	3210	8430		1947 - 13
1948	8/10	6.80	7.10	6.70	5.45	9.70(7)	4.80	8/10	M 22.7	6070	2620	8690	(7)8/4	1948 - 12
1949	7/28	5.40	5.30	6.50	6.10	6.80(8)	3.80	7/28	M 22.7, M 26.5	7280	3890	11170	(8)7/27	1949 - 10
1950	8/29	6.50	5.50	6.80	7.10	6.90(9)	3.10	8/31	M 26.5, M 30.5	6480	3160	9640	(9)8/30	1950 - 12
	9/19	6.50	8.10	8.00	6.80	6.50(10)	3.90	9/21	M 30.5	5950	3190	9040	(10)9/14	
1951	8/16	4.60	6.05	6.55	6.00	5.90(11)	5.00	8/14	M 30.5	10060	5990	16050	(11)8/15	1951 - 10
	8/9	4.80	7.30	6.70	6.00	5.70(12)	4.20	8/7	M 26.5	10060	5990	16050	(12)8/1	
	8/21	4.90	6.80	7.90	7.15	7.00(13)	5.40	8/22	M 33.9	10060	5990	16050	(13)8/28	
1952	8/12	4.60	6.80	6.50	6.20	6.30(14)	5.90	8/14	M 30.5	20580	9440	30020	(14)8/21	1952 - 13
	8/7	4.65	6.20	5.95	5.40	5.40(15)	5.80	8/6	M 30.5	20580	9440	30020	(15)8/5	
	7/15	4.70	6.30	5.70	5.60	5.95(16)	5.60	7/17	M 30.5	30830	18140	48970	(16)7/10	
1953	7/16	4.30	5.85	5.75	5.40	6.55(17)	5.85	7/16	M 37.8	28750	10560	39210	(17)7/11	1953 - 11
1954	8/18	4.60	6.20	6.55	5.85	6.15(18)	3.10	8/18	M 26.5	6590	4240	10830	(18)8/11	1954 - 11
1955	8/24	2.90	4.50	5.50	4.50	----	2.00	8/23	M 26.5	9900	9100	19000		1955 - 10
	8/16	3.05	6.50	5.75	4.60	5.15(19)	2.85	8/17	M 30.5	9900	9100	19000	(19)8/18	
	8/10	4.90	5.70	5.15	5.05	----	3.80	8/11	M 30.5	9900	9100	19000		
1956	9/18	6.75	6.30	7.15	6.80	7.70(20)	3.10	9/19	M 26.5	4750	3150	7900	(20)9/20	1956 - 11
	9/25	6.75	8.40	8.20	7.80	----	3.70	9/26	M 22.7	4750	3150	7900		
1957	8/6	4.85	5.20	6.05	5.55	6.05(21)	4.80	8/8	M 33.9	17700	4160	21860	(21)8/7	1957 - 7

* St. Croix River

** Mean Monthly Discharge; M 13.8 - Miss. R. flow at Robert St. plus MSSD flow; M 42.8 - Miss. R. flow measured downstream of confluence with St. Croix R.; M 41.7 - St. Croix River flow (difference between M 13.8 and M 42.8)

APPENDIX - E
(Cont'd)

JULY - AUGUST - SEPTEMBER COMPARATIVE DISSOLVED OXYGEN VALUES IN THE MISSISSIPPI AND ST. CROIX RIVERS USING ,INIMUM DISSOLVED OXYGEN VALUES AT SAMPLING STATION M 41.7 AS A BASE

Year	Date	Minimum DO at M 41.7*	Corresponding DO Values on Same Date				Low DO Values in Hastings Pool			Discharge, cfs**			Remarks	No. of Samples Represented
			M 37.8	M 39.1	M 52.5	M 56.1	DO	Date	Station	M 13.8	M 41.7	M 42.8		
1958	7/16	4.50	5.75	5.75	5.00	5.50(22)	2.20	7/16	M 30.5	6031	9509	15540	(22)7/15	1958 - 11
1959	9/15	6.10	5.70	6.00	6.00	6.65	2.70	9/15	M 22.7	5269	4408	9677		1959 - 12
1960	9/28	4.70	6.20	7.00	6.00	6.30(23)	2.80	9/29	M 30.5	6786	3784	10570	(23)9/27	1960 - 11
1961	9/26	6.20	3.50	5.80	5.20	5.40	1.70	9/27	M 26.5					1961 - 10

APPENDIX - F

JULY - AUGUST - SEPTEMBER COMPARATIVE DISSOLVED OXYGEN VALUES IN THE MISSISSIPPI AND ST. CROIX RIVERS USING MINIMUM DISSOLVED OXYGEN VALUES AT SAMPLING STATION M 56.1 AS A BASE

Year	Date	Minimum DO at M 56.1	Corresponding DO Values on Same Date				Low DO Values in Hastings Pool			Discharge, cfs**			Remarks	No. of Samples Represented
			M 37.8	M 39.1	M 41.7*	M 52.5	DO	Date	Station	M 13.8	M 41.7	M 42.8		
1942	7/16	5.60	5.30	5.20	6.90	5.50	3.15	7/14	M 22.7	9820	5600	15420		1942 - 11
1943	7/15	4.60	4.35	4.35	5.85	4.90	3.70	7/14	M 30.5	22890	8900	21790		1943 - 11
	8/11	4.90	5.15(1)	4.50	5.80	5.20	4.50	8/9	M 26.5	13460	5400	18860	(1)8/9	
1944	7/11	5.30	5.95(2)	5.70(2)	4.50	5.30	5.90	7/13	M 26.5	27960	11920	39880	(2)7/13	1944 - 11
	7/20	5.30	6.10	5.50	4.10	5.10	5.70	7/19	M 30.5	27960	11920	39880		
1945	8/1	5.70	4.50(3)	5.45	6.05	5.90	4.20	8/2	M 33.9	10050	5800	15850	(3)8/2	1945 - 9
1946	7/8	5.05	6.30	5.70	5.00	5.20	5.00	7/9	M 30.5, M 33.9	19590	11690	31280		1946 - 12
1947	7/11	5.60	5.10	5.10	9.10	5.70	5.10	7/11	M 37.8	18990	3520	22510		1947 - 13
	7/17	5.60	4.70	3.90	9.80	5.00	4.40	7/14	M 26.5	18990	3520	22510		
1948	7/8	5.20	8.90	8.30	9.10	3.90	1.40	7/8	M 26.5	4810	2960	7770		1948 - 8
1949	8/31	6.10	5.90(4)	7.05(4)	5.65(4)	6.20(4)	2.10	8/23	M 22.7	6890	2630	9520	(4)8/24	1949 - 7
	9/7	6.10	5.00	5.50	5.70	5.90	1.50	9/9	M 30.5	4800	2100	6900		
1950	9/14	6.50	8.10(5)	8.00(5)	7.10(6)	5.90(6)	3.30	9/12	M 22.7	5950	3090	9040	(5)9/19 (6)9/13	1950 - 7
1951	7/19	5.70	6.40(7)	5.50(7)	5.50(7)	5.30(7)	4.80	7/17	M 30.5	21710	12620	34330	(7)7/18	1951 - 6
	8/1	5.70	6.30(8)	6.55(8)	5.15(8)	5.80(8)	4.40	8/2	M 26.5	10060	5990	16050	(8)7/31	
1952	8/5	5.40	6.20(9)	5.95(9)	4.65(9)	5.40(9)	5.80	8/6	M 30.5	20580	9440	30020	(9)8/7	1952 - 5
1953	7/23	5.65	5.00(10)	4.95(10)	5.10(10)	5.45(10)	4.85	7/22	M 30.5	28750	10460	39210	(10)7/21	1953 - 5
1954	7/15	4.85	5.15(11)	5.10(11)	5.55(11)	6.25(12)	4.75	7/13	M 33.9	15680	12510	28190	(11)7/14 (12)7/21	1954 - 6
1955	8/18	5.15	6.50(13)	5.75(13)	3.05(13)	4.60(13)	2.85	8/17	M 30.5	9900	9100	19000	(13)8/16	1955 - 3
1956	8/8	5.55	5.50(14)	4.55(14)	8.55(14)	5.00(14)	4.30	8/7	M 33.9	12600	4960	17560	(14)8/9	1956 - 5
1957	7/25	5.15	4.60(15)	4.60(15)	5.50(15)	4.90(15)	4.60	7/23	M 30.5, M 33.9	36830	11390	48220	(15)7/24	1957 - 3
1958	7/15	5.50	5.75(16)	5.75(16)	4.50(16)	5.00(16)	2.20	7/16	M 30.5	6031	9509	15540	(16)7/16	1958 - 14
1959	8/27	4.15	3.35	4.05	8.20	4.15	0.25	8/27	M 22.7	3304	3019	6323		1959 - 13
	8/18	4.80	5.30	5.40	7.65	4.80	0.25	8/27	M 22.7	3304	3019	6323		
1960	8/30	5.00	7.15(17)	6.45(17)	7.20(17)	5.40(17)	0.75	8/31	M 26.5	3767	4855	8622	(17)9/1	1960 - 12
1961	8/1	4.30	2.20	3.40	8.55	4.30	0.10	8/1	M 20.5, M 22.7					1961 - 13

* St. Croix River

** Mean Monthly Discharge; M 13.8 - Miss. R. flow at Robert St. plus MSSD flow; M 42.8 - Miss. R. flow measured downstream of confluence with St. Croix R.; M 41.7 - St. Croix R. flow (difference between M 13.8 and M 42.8)

EXHIBIT F

MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT
SUMMARY STATEMENT
TO
MINNESOTA STATE BOARD OF HEALTH
MINNESOTA WATER POLLUTION CONTROL COMMISSION
REGARDING HEARINGS FROM MAY 28, 1962, TO SEPTEMBER 22, 1962
OCTOBER 1, 1962

The District's Interest in Proposed River Water Quality Standards

The Minneapolis-Saint Paul Sanitary District has a vital and direct interest in the proposed classification and adoption of standards for the Mississippi River in the vicinity of Minneapolis and Saint Paul. The District's principal area of control involves that section of the river from the Pig's Eye Lake Sewage Treatment Plant to the mouth of the St. Croix River. Into this zone of the river, the effluent from the District's treatment plant is discharged, utilizing, to a reasonable extent, the natural assimilative capacity of the river for the completion of the stabilization process. As the sewerage system tributary to the District's treatment plant serves over 90 percent of the Metropolitan Area's sewered population, the plant effluent is the major source of pollution in the down-river section. Other communities and industries also contribute substantial pollutional loads to the river and share the responsibility for the present and future river water conditions.

Because of the direct bearing of the extent and cost of sewage treatment on the maintenance of various levels of quality of the river water, the District endorses reasonable standards for river water quality which are commensurate with the downriver water uses. It is, however, an economic necessity to make reasonable use of the diluting and natural purification afforded by the receiving stream.

Treatment Objectives of Past Years

Placed in operation during the summer of 1938, the treatment plant at Pig's Eye Lake was designed to provide treatment for an average sewage flow of 134 million gallons per day expected from a tributary population of 910,000.

Over the years, 24 suburban communities have chosen to contract with Minneapolis or Saint Paul as the most advantageous solution to their sewage disposal problem, increasing the sewage flow to the plant to 162 MGD in 1961 from an estimated tributary population of 1,110,000.

Treatment objectives were based upon a statement of requirements issued by the Minnesota State Board of Health in 1928. The statement provided essentially that the pollution of the river should be restricted to such an extent that the public health hazard would be reduced to a minimum, that the health of livestock would not be endangered, that the public nuisance would be eliminated, and that fish life in the river, at least below the mouth of the St. Croix, would not be jeopardized.

Over the years the District has established approximately 24 river water sampling stations which extend 93 miles from North Minneapolis down through Lake Pepin. Annually more than 600 regularly scheduled river samples are collected and over 5,000 analytical determinations of the water quality are made.

A detailed analysis of the water quality sampling results has shown that low dissolved oxygen levels have been recorded in the Hastings pool in recent years. The increase in occurrence of lower DO levels in recent years in the Hastings pool can be attributed in a large measure to unfavorable river flows and increased pollution loads in the effluent discharges from the Minneapolis-Saint Paul Sanitary District's sewage treatment plant, the South Saint Paul sewage treatment plant, and other municipal and industrial installations above and below these plants. Except in 1949, water quality objectives were met in all years prior to 1956 and they were met in 1957 and in 1962. Conditions in the Red Wing pool (below the mouth of the St. Croix) with respect to dissolved oxygen level have been satisfactory over all years through 1961, with no dissolved oxygen level lower than 3 ppm being recorded.

Program of Research and Investigation

In 1956 the Board of Trustees of the Minneapolis-Saint Paul Sanitary District authorized a five-year Program of Research and Investigation to assist in the determination of future requirements for Sanitary District sewage works. The overall program was directed toward the determination of the most economical and satisfactory solution to the sewage disposal problem of the Minneapolis-Saint Paul Metropolitan Area. The research phase of the program included comprehensive analysis of the past thirty-five years' records of river condition and the prediction of the capacity of the Mississippi and Minnesota Rivers to receive and assimilate the pollution discharged from sewage treatment plants and other sources in the area. The investigation part of the program involved an evaluation of the existing interceptor sewer system to determine its adequacy to convey expected future flows from an enlarged area of service and the development of a long-range plan for the expansion of sewage works in the Metropolitan Area. Reports on these studies have been submitted as exhibits.

As a part of the District's studies, a plan was developed for the expansion of the existing sewage works required to serve a growing metropolitan area to the year 2000. From an investigation of many alternate sewage works projects to serve the area, four advantageous projects were presented in the reports. These included sub-projects for the Northwest Region, an area of 229 square miles (19 communities) which essentially includes the North Suburban Sanitary Sewer District.

It was concluded in the reports that a new interceptor sewer from the Northwest Region to the west terminus of the existing Joint Interceptor Sewer was a feasible project. On a long-range basis, the estimated cost of construction of this interceptor sewer and the necessary enlargement of the Pig's Eye Lake sewage treatment plant is approximately the same as that of an upriver regional sewage treatment plant to serve the Northwest Region.

A detailed evaluation of the capacity and utilization of the Minneapolis-Saint Paul Sanitary District's Joint Interceptor extending from the west limits of St. Paul to the Pig's Eye Lake treatment plant has shown that under the "A-1" or "B-2" project, capacity will be available to convey the sewage from the Northwest Region under year 2000 requirements. Future utilization of the Joint Interceptor is dependent to an extent upon the storm water separation programs of Minneapolis and Saint Paul.

Proposed Expansion of Treatment Plant

A three-year construction program was adopted recently by the Minneapolis-Saint Paul Sanitary District which is aimed at the completion of a plant expansion project and the commencement of secondary treatment operations in 1965. Final contract plans are presently being prepared for this treatment plant enlargement, based upon employment of the high-rate activated sludge process. Treatment requirements in excess of 75 percent removal of 5-day BOD will be met with non-continuous supplementary processes such as chlorination and direct river aeration. The estimated cost of this expansion project is $22,800,000. The Minneapolis-Saint Paul Sanitary District is, therefore, actively proceeding with treatment works which, when completed, will result in improved river conditions and compliance with the proposed river standards.

Though the proposed standards do not apply to the Red Wing pool downstream from the mouth of the St. Croix, water quality in this part of the river will also be maintained at satisfactory levels as indicated by the statement dated July 19 and presented at the hearing of September 22.

While the proposed expansion of the treatment plant is based upon the year 1980 development of the Central Cities and 24 contracted suburbs, the 218 MGD design provides capacity in excess of present requirements to the extent of 56 MGD. Should other areas contract for service, including the North Suburban Sanitary Sewer District, the plant will be able to handle the additional flow. The effect of inclusion of sewage from areas outside the design area will be to shorten the design period or to require further expansion at an earlier date than 1980. As planned, the secondary plant layout will facilitate future incremental expansion of the treatment plant as may be necessary.

Degree of Treatment and Its Relation to Low Flow Augmentation of the River

The Minneapolis-Saint Paul Sanitary District's study reports on the proposed degree of treatment are extensive and complicated. Perhaps the best brief presentation of this subject is contained on pages 10 through 16 of the statement on the "Regulation of the Mississippi River Headwater Reservoirs" presented at the

June 27, 1962 hearing held by the U. S. Army District Engineer in Grand Rapids and introduced as evidence at the Water Pollution Control Commission hearing on September 21, 1962.

With more than half the population of the State expected to be concentrated in the Minneapolis-Saint Paul metropolitan area before 1980, it becomes imperative to secure adequate stream flow for water supply, stream sanitation and other needs. The sanitation situation will be further aggravated if a 12-foot navigation channel is constructed, as compared with the present 9-foot channel.

Preliminary studies by the Army Engineers St. Paul District office, indicate that a considerable amount of low flow augmentation from the reservoirs is practicable. Cost estimates for the expanded Minneapolis-Saint Paul Sanitary District Plant indicate that reasonable amounts of low flow augmentation would effect substantial savings in sewage treatment costs and would permit the further upgrading of the river water quality.

Summary

With our engineering staff and our consulting engineers, we have reviewed the standards as proposed for three sections of the Mississippi River. Based upon the extensive studies of the pollution and recovery characteristics of the river made as a part of the Program of Research and Investigation, knowledge of the workings of the main sewerage system of the Metropolitan Area, and th experience of administering and operating the present sew treatment plant, we concluded that the proposed standards are reasonable and proper.

Population estimates indicate that nearly 60 percent of the population of the State will be centered i the Minneapolis-Saint Paul Metropolitan Area in the year 2000. Considering these projections and the sanitation problems which they imply, it would appear that whether th contract system to suburban communities is extended or a metropolitan agency is formed, the basic objectives of the river standards will be accomplished through the collectio and conveyance of sewage to a treatment plant or plants located downstream from the major concentration of population of the Metropolitan Area.

For the Minneapolis-Saint Paul Sanitary Distric

/s/ D. D. Wozniak, Attorney

/s/ Kerwin L. Mick, Chief Engineer
and Superintenden

Approved by the Board of Trustees
October 1, 1962

* * *

MR. MICK: That concludes my formal statement.

I wonder, Mr. Chairman, if any of the people who submit statements here today will have an opportunity to read and comment on the previous statements that have been made here today?

MR. STEIN: Well, you have the floor now. The general rule is that when you are called on to make your statement, you have free sailing. Go ahead.

MR. MICK: What I mean by that is, we thought we heard some statements that were made with regard to BOD in the river, and so forth, that didn't seem to be quite correct.

MR. STEIN: Go right ahead.

MR. MICK: And in order to be sure they are correct, we would have to see the statements.

MR. STEIN: Were those statements by some of the technical people of the Federal Government, or the States?

MR. MICK: One of them was Mr. Jordahl of the Department of the Interior.

MR. STEIN: He isn't here now. I think this is one of the things that we certainly want to be right on.

I know Mr. Jordahl, and he is one of the best public service men we have. He is the Department of the Interior's coordinator for this region. I am sure Mr. Jordahl, on something like a BOD, has taken information which has been given to him.

Now that we have flagged this, I will ask our technical people to get together with you and see what the point is, and we can take this up with Mr. Jordahl and see if we can make an adjustment.

MR. MICK: Well, Mr. Winiewski has given me a copy of his statement here, and he points out the paragraph that I have in mind, if I can just refer to it?

MR. STEIN: Go right ahead.

MR. MICK: He says that in February of 1962, the DO's averaged 0.5 parts per million between the bridge and dam at Hastings and Anoka. I don't think that is correct because I don't know what bridge he is referring to. We don't sample any place between a bridge and a dam. We sample at the dam, and then below the dam at the bridge, and the DO at the bridge is always considerably higher than at the dam because of the aeration through the dam.

Maybe the bridge he is referring to is a bridge above there like the Roberts Street Bridge. We were wondering whether he was referring to the old Hastings Pool.

Anyway, for February 1962, we did check on our figures for that. The DO ranges from 6-½ parts per million at Mile 20, which is down at South St. Paul, to 6.2 at Mile 22.7, 4.7 at Mile 26.5, 3.15 at Mile 30.5, and finally you get down to the dam itself at Mile 37.8, and it was lower there in February. It was 0.4, but it isn't averaged in the pool anywhere near that. That is just one station.

Then there was Mr. Spriggle's remark on the Red Wing plant. He referred to some cost figures there of, I believe, $12 to $13 per capita versus a dollar and a half for our plant.

Well, I think that is like comparing apples and oranges, you might say, because, in the first place, our figure of $1.50 did not include the cost of operation and maintenance of any of the sewer systems that are connected to our plant. There are some almost 3,000 miles for that, except for one 9-mile section just above the plant. The cost per capita in a smaller plant is always larger than it is in the larger plant.

That is what I meant by saying if we had an opportunity to read over these statements and make comments on questions like that, it would help.

MR. STEIN: Yes.

MR. MICK: I would just like to point out, in concluding, that any standards that are set any time, in my opinion, should always be reasonable. Anything they do has to be reasonable and realistic -- that is, actually capable of being achieved at all times.

I would just like to bear that in mind whenever we talk about standards, because in many cases they can be achieved part of the time, or a good share of the time, bu not all the time.

MR. STEIN: Thank you. Do you want to wait ju a moment, Mr. Mick?

MR. MICK: Yes.

MR. STEIN: By the way, I thoroughly agree with you on that last sentiment. I think it would be better for the operating plants and the people having the responsibility for running plants and the regulatory agencies if you had standards which could be met at all times.

MR. MICK: It is very discouraging.

MR. STEIN: And you could come out there on any day and know whether the standards are met. Both sides would know what the situation was.

I don't think that those are impossible of achievement either.

MR. MICK: What I meant there was that it is a little bit discouraging to ask for a larger amount of money than is necessary to build plants to meet standards that our conditions indicate could not be met.

I don't mean by that the existing standards, but if they are raised too high, to a point that I have heard people comment on at various times, we can show from our conversations that these can never be met 100 percent of the time, and therefore they are not realistic.

MR. STEIN: Mr. Wilson?

MR. WILSON: Mr. Mick, may I just call your attention to a point?

In this statement that you have submitted, you have stated that the treatment works which the District has under construction, when completed, will result in improved river conditions and compliance with the proposed river standards. Is that still your opinion?

MR. MICK: Yes.

MR. WILSON: Now, this statement was submitted by the District at the hearings before those standards were actually adopted.

MR. MICK: That is correct.

MR. WILSON: Have you examined the standards that were adopted after the conclusion of those hearings?

MR. MICK: Yes.

MR. WILSON: Does the District still adhere to the statement here that your works, when completed, will comply with the standards as actually adopted?

MR. MICK: Yes.

MR. WILSON: I want to point out, Mr. Chairman, that with the exception of the appeal taken by the North Suburban Sanitary Sewer District from the standards for the upper zone of the river, no appeals have been taken by the Twin Cities District, the City of Minneapolis and St. Paul, or South St. Paul, or by anyone else, and the time for appeal has expired.

MR. STEIN: Thank you.

Are there any other comments or questions here?

(No response.)

MR. STEIN: What kind of plant do you propose for that 75 percent removal?

MR. MICK: High rate activated sludge.

MR. STEIN: Generally speaking, is this about the level you expect from this plant? Supposing you need more. You indicated you could provide a higher degree of treatment, that it is readily expandable.

Would you provide the same kind of treatment, high rate activated sludge? What actually would you do?

MR. MICK: Well, the high rate activated sludge plant is being constructed merely by having additional aeration tanks, and with more aeration you can go up to, if not conventional activated sludge, at least to the region where you get 90 percent or more.

MR. STEIN: You believe with 75 percent reduction, you are going to meet the standards?

MR. MICK: We were a little bit worried about 100 percent of the time.

For a very small percent of the time, we might have trouble, but we have in mind auxiliary measures to tide us over for those very small percentages of the time; and those auxiliary measures are such things as heavy chlorination of the effluent and direct aeration at the dam, which we have been working with the Corps of Engineers on, as Colonel Harding said. This is more than double the aeration we were getting there. That is what we are considering, which would tide us over those small percentages of the time.

MR. STEIN: As I understand this --

MR. MICK: Also -- excuse me?

MR. STEIN: I'm sorry.

MR. MICK: We are also hoping that we should be entitled to some low flow augmentation at the critical low flows that occur on the river.

MR. STEIN: Well, I don't know how optimistic you could be for low flow augmentation with 75 percent reduction.

MR. MICK: Isn't that classed as secondary treatment?

MR. STEIN: Well, it is secondary treatment, but you are kind of scraping the low end of the spectrum.

MR. MICK: I think it is conventional for high rate activation. We hope we can get more than that.

MR. STEIN: I don't want to preclude this, and I certainly don't know all the facts. I want to be open on this.

There is one more question for my own clarification here. I don't know that it is completely clear. As I understand this, this $23 million plant will just serve the areas under your jurisdiction now, and not these proposed new metropolitan-wide sanitary districts for which the legislation did not pass. Is that correct?

MR. MICK: That is not entirely correct. It is being designed to serve the two cities and 24 suburbs that were connected at the time the design was closed up, until the year 1980 -- their growth up to the year 1980.

MR. STEIN: I understand, but if this bill had passed in the 1961 session, there would be more areas in there which would not be taken care of, or could not be taken care of, by your design capacity in this plant. Is that correct?

MR. MICK: If, as a result of this Ashbach Bill plan, for example, we should have in the near future most of the rest of the suburbs in the metropolitan area, then the plant that is being built now would still take care of them, but not up until 1980 -- maybe only until 1970 or 1975. Then it would have to be expanded again.

MR. STEIN: Then I am missing something there in the middle.

In Paragraph (3) you say, "Although the 1961 session of the state legislature failed to pass enabling legislation for the creation of a metropolitan-wide sanitary district...." That is in Paragraph (3) of your statement. Is that right?

MR. MICK: Yes.

MR. STEIN: If we go along with the assumption that lightning would strike, or by some hypothetical situation that the legislation had passed, would this plant expansion of $23 million that you are proposing now be sufficient to have taken care of that whole metropolitan-wide area that was proposed in the 1961 legislation?

MR. MICK: It would for a few years; very few years.

MR. STEIN: And then it would have to be expanded again?

MR. MICK: Yes.

MR. STEIN: Thank you.

MR. WILSON: Mr. Chairman, may I?

MR. STEIN: Yes.

MR. WILSON: Right on that point, I think this will clarify it.

Will you step over here to the map, Mr. Mick?

First, the fact is that the Minneapolis-St. Paul Sanitary District consists of the area within the city limits of Minneapolis and St. Paul, does it not?

MR. MICK: Yes.

MR. WILSON: Will you point out on the map the limits of the cities of Minneapolis and St. Paul?

MR. MICK: Here (indicating).

MR. WILSON: That is a comparatively small section of this entire area. Here is a pointer, so you can get back.

MR. MICK: Yes (indicating).

MR. WILSON: Now, then, they have undertaken by contract to serve a considerable surrounding territory, which is indicated by the blue line.

Will you run your pointer around the blue line showing the territory outside the Twin Cities that is now being served, the suburban territory now being served by contract?

MR. MICK: Here (indicating) and also up here too (indicating).

MR. WILSON: And that includes these 42 cities, villages, and other suburban units that have been referred to

MR. MICK: Yes.

MR. WILSON: Now will you run your pointer around the black line, which shows the boundaries of the district that was described in the 1963 revised bill for creation of a metropolitan-wide sanitary district?

MR. MICK: Yes (indicating).

MR. WILSON: That includes these outlying towns, where there is big suburban development that was described here, of Burnsville and Eagan and Cottage Grove over in Washington County, and a very considerable area outside, which includes about all the territory that would be within such a district in the foreseeable future, does it not?

MR. MICK: Yes.

MR. STEIN: In other words, what is the red line, the bill that failed?

MR. WILSON: That was 1961.

MR. STEIN: That's right. In other words, you kind of modified your proposal and pulled in your horns a little bit on your new proposal.

MR. MICK: It is pulled in mostly on the corners there.

MR. WILSON: Yes. One of the objections to the 1962 proposal was that it took in too much territory

MR. STEIN: Yes. Well, I think that certainly clarifies it for me on what the factual situation is.

Are there any further comments or questions?

MR. MICK: Thank you.

MR. STEIN: Thank you very much.

MR. SMITH: We have ten copies of a statement from South St. Paul.

STATEMENT OF JOHN P. BADALICH, CITY ENGINEER, CITY OF SOUTH ST. PAUL, MINNESOTA

MR. BADALICH: We have submitted ten copies of the statement here, and if you would like us to get up and read the oral summary of one of the statements, we will certainly be glad to do it. Otherwise, everything is self-explanatory in that statement.

MR. SMITH: I believe possibly your statement should be read.

MR. BADALICH: All right.

Mr. Chairman, distinguished conferees, ladies and gentlemen:

I SEWAGE TREATMENT PLANT

The City of South St. Paul owns and operates the second largest sewage treatment facility in the Twin City Metropolitan Area. Located also in South St. Paul is the nation's second largest meat packing and stockyards center, being the second largest industry in the State of Minnesota, second only to agriculture itself.

The South St. Paul Sewage Treatment Plant is located near the southerly city limits of the City of South St. Paul on the west bank of the Mississippi River, approximately 3-½ miles downstream from the Minneapolis-St. Paul Sanitary District Plant. The City of South St. Paul is a city of the second class, with a population of 22,032 (1960 Census), having an industrial and sanitary sewage flow with a population equivalent of 792,000. This arises by reason of the character and volume of the sewage wastes from the major meat packing center located in the city.

Many persons confuse the South St. Paul Sewage Treatment Plant with the Minneapolis-St. Paul Sanitary District Plant. The latter treats the sewage from Minneapolis and St. Paul, while the former handles the sewage and industrial wastes from the City of South St. Paul, a separate city and adjacent to and southerly from the St. Paul city limits.

Prior to 1940, the large packing plants of Armour and Swift and several small packing plants in the City of South St. Paul discharged wastes into the Mississippi River without treatment. This was not an intentional misuse of public property, since for many years it appeared that the 11,800-sec. ft. average flow of the Mississippi River was large enough to take care of the sewage of

Minneapolis, St. Paul and South St. Paul by dilution. No doubt this was an influencing factor in the location of these industries.

In 1914, however, the Twin City Lock and Dam was built. This created a large quiescent pool which rapidly became offensive due to its septic condition and to floating sludge solids. It became apparent that the Twin Cities must do something about the sewage which emptied into this pool; but before plans could be made for corrective measures, the Federal Government came out with a River and Harbors program. This program was the "Nine Foot Channel Project" which would make possible large barge traffic on the Mississippi, up to St. Anthony Falls.

To create the 9-foot channel required for this improvement below the Twin City Lock and Dam and through the Cities of St. Paul and South St. Paul, another lock and dam had to be built about 30 miles below the Twin City Dam. This dam is now known as Hastings Dam.

When the 9-foot channel project was announced, it was obvious that on its completion the Twin Cities and South St. Paul would have two septic pools instead of the one previously mentioned. Accordingly, interested parties such as the Minnesota Public Health Department, the Metropolitan Drainage Commission and the South St. Paul engineers carried out extensive studies to determine what should be done to eliminate the pollution of the Mississippi. These studies showed that (1) it was advisable for the Twin Cities and South St. Paul to treat their wastes (this was upheld by the Minnesota State Legislature and in 1933 a law was passed making it mandatory for the metropolitan area to treat all its sewage and industrial waste); (2) the Cities of St. Paul and Minneapolis should build a sewage treatment plant; and (3) the City of South St. Paul should build a sewage treatment plant.

Therefore, recognizing its responsibility with respect to both sewage collection and treatment and upon completion of preliminary studies, the City of South St. Paul proceeded with the construction of the necessary intercepting sewers and a sewage treatment plant at a total cost of $1,235,227.04. The South St. Paul plant, as designed and constructed, is one of primary treatment plus single stage filtration and final settling with facilities for chlorination and provides for the removal of solids and disposal of same in open sludge lagoons. Basic operation consists of processing the sewage through grit chambers, flocculation tanks, primary clarifiers, filters and final clarifiers, with final disposal being made into the Mississippi River. Final effluent during normal operation flows by gravity through a 48-inch outfall line to the river.

When the river elevation rises to a point where gravity flow is not possible, the final effluent is then diverted to Wet Well No. 3 of the control building. By means of two 10 MGD pumps and one 5 MGD pump, the effluent is pumped from the outfall line to the river.

Operating records through 1962 show that the South St. Paul Treatment Plant processes approximately 12,000,000 gallons of sewage daily, consisting of an average flow of 13.04 MGD for weekdays, and 6.94 MGD for Sundays and holidays. Raw sewage BOD (Biochemical Oxygen Demand) is 1356 ppm for weekdays and 168 ppm for Sundays and holidays (based on average daily flows from April 1962 through March 1963). An average BOD removal of approximately 67 percent was achieved during the few years preceding the year 1963. Also the overall removal of settleable solids was 86.6 percent for the same period.

In an effort to improve the quality of the existing sewage treatment effluent, studies and pilot plant operations beginning in September 1958 were conducted by the superintendent and chemist of the South St. Paul Treatment Plant on further treating the plant effluent by use of an anaerobic waste stabilization pond. The report entitled "History of the South St. Paul Anaerobic Waste

Stabilization Pond to November 1, 1963" accompanies this presentation.

After years of further study and tests, this method of additional treatment of the plant effluent proved conclusive so that in November 1961 the City of South St. Paul engaged the consulting engineers, firm of Comstock & Davis, to prepare a preliminary report and plan on a proposed sewage stabilization pond.

After completion of this report and acceptance by the Minnesota State Board of Health, final plans and specifications were prepared and bids received on May 7, 1962, for the construction of this 27-acre pond. Total cost was in excess of $155,000, which included $13,500 for land acquisition.

In February of 1963, the plant effluent was pumped into the stabilization pond and the pond put in operation. After a short operation, leakage was detected and the pond drained and the inside of the dike was sealed with an impervious clay material. In May of 1963, the pond was again filled and a short time later relatively uniform operation was achieved with the following results in sewage treatment based on a six-month operational average.

The overall average BOD removal was increased to 88.2 percent. The overall removal of suspended solids was an average of 94.9 percent. From these results, it is seen that the overall efficiency of our sewage treatment operation has increased well over 50 percent. In BOD removal alone through use of the stabilization pond, the BOD loading to the river has decreased in excess of 60 percent over the amount previously discharged from the main plant.

In view of the above improvement, it is evident that the City of South St. Paul has recognized its responsibility further with respect to sewage treatment and river conditions and that we in South St. Paul have been able to meet efficiently and effectively, our needs for sewage treatment and disposal.

II STORM SEWERS

The City of South St. Paul, like the Cities of St. Paul and Minneapolis, being one of the older municipalities in the metropolitan area, has a combined sanitary and storm sewer system.

Here again, the City of South St. Paul has recognized its responsibility of discharging diluted sewage into the Mississippi River during the time of rainfall and surface runoff. Since 1955 the city has expended funds to separate both systems of sewerage collection.

J. P. Badalich

In 1955, in conjunction with the building of Highway Interstate 494, the City of South St. Paul constructed a 120" storm water outlet to the Mississippi River so as to provide an outlet for storm water drainage from the southern half of the city. The cost of this river outlet was in excess of $500,000. Then again in 1957, $1,300,000 in bonds were issued for the construction of storm sewers within the city, thereby eliminating many miles of combined sewers. With part of this bond money, a 60" storm outlet to the Mississippi River was also constructed in the north end of the city, eliminating again some combined sewers. To this date, the entire bond issue has been expended and additional monies are being used to further this separation of storm and sanitary sewers.

Presently and since the start of the separation of storm and sanitary sewers, all new sewer construction and additions to the sewerage system is accomplished under a separate basis.

In conclusion, we in South St. Paul are one existing unit of government that has successfully met its responsibilities in respect to sewage collection, treatment and disposal and will continue to do so in the future.

* * *

J. P. Badalich

SEWAGE TREATMENT AT SOUTH ST. PAUL, MINNESOTA

The South St. Paul Sewage Treatment Plant is located near the southerly city limits of the City of South St. Paul on the west bank of the Mississippi River approximately 4-½ miles downstream from the Minneapolis-St. Paul Sanitary District Plant. The City of South St. Paul is a city of the second class with a population of 22,032, having an industrial and sanitary sewage flow with a population equivalent of 553,000.

Many persons confuse the South St. Paul Sewage Treatment Plant with the Minneapolis-St. Paul Sanitary District Plant. The latter treats the sewage from Minneapolis and St. Paul, while the former handles the sewage and industrial wastes from the City of South St. Paul, a separate city and adjacent to and southerly from the St. Paul city limits.

Prior to 1940, the large packing plants of Armour and Swift and several small packing plants in the City of South St. Paul discharged wastes into the Mississippi River without treatment. This was not an intentional misuse of public property, since for many years it appeared that the 11,800-sec. ft. average flow of the Mississippi

River was large enough to take care of the sewage of Minneapolis, St. Paul and South St. Paul by dilution. No doubt this was an influencing factor in the location of these industries.

In 1914, however, the Twin City Lock and Dam was built. This created a large quiescent pool which rapidly became offensive due to its septic condition and to floating sludge solids. It became apparent that the Twin Cities must do something about the sewage which emptied into this pool; but before plans could be made for corrective measure, the Federal Government came out with a River and Harbors program. This program was the "Nine Foot Channel Project" which would make possible large barge traffic on the Mississippi, up to St. Anthony Falls.

To create the 9-foot channel required for this improvement below the Twin City Lock and Dam and through the Cities of St. Paul and South St. Paul, another lock and dam had to be built about 30 miles below the Twin City Dam. This dam is now known as Hastings Dam.

When the 9-foot channel project was announced it was obvious that on its completion the Twin Cities and South St. Paul would have two septic pools instead of the one previously mentioned. Accordingly, interested parties such as the Minnesota Public Health Department, the Metropolitan

Drainage Commission and the South St. Paul engineers carried out extensive studies to determine what should be done to eliminate the pollution of the Mississippi. These studies showed that (1) it was advisable for the Twin Cities and South St. Paul to treat their wastes (this was upheld by the Minnesota State Legislature and in 1933 a law was passed making it mandatory for the metropolitan area to treat all its sewage and industrial waste). (2) The Cities of St. Paul and Minneapolis should build a sewage treatment plant, and (3) the City of South St. Paul should build a sewage treatment plant.

Upon completion of preliminary studies, the City of South St. Paul proceeded with the construction of the necessary intercepting sewer and a sewage treatment plant at a total cost of $1,235,227.04. The South St. Paul plant as designed and constructed is one of primary treatment plus single stage filtration and final settling, with facilities for chlorination, and provides for the removal of solids and disposal of same in open sludge lagoons. Expected removals and reduction of oxygen demand is 70 percent. Funds were not available for the inclusion of sludge treatment units for incineration, but the plant was laid out to permit the future addition of these units if they become necessary. Operating records up to the present time show that expected removals can be exceeded and that the type of treatment and design of plant has been very satisfactory.

The plant was designed on the basis of 10 MGD flow. The raw sewage first passes through one inch manually cleaned bar screens. Thence to Wet Well No. 1 and raw sewage pumps which are two 10 MGD and one 5 MGD motor-driven units located below sewer level for continuous prime; one 10 MGD pump is equipped with gas drive unit (125 H.P.) able to pump up to 13 MGD rate in case of power failure.

The sewage is pumped from Wet Well No. 1 to the three unit primary settling (roughing) tanks through Venturi meters. Each primary unit is 10.5 ft. wide by 8 ft. water depth by 110 feet long, affording a 30-minute detention at 10 MGD rate. Each tank is equipped with sludge and grit removal mechanisms and skimming and scum removal mechanisms.

Sludge from the primary tanks is carried by a cross conveyor to an ejector and ejected by air to lagoons. As this material piles up some is burned and some is sold to a processing plant for use as a fertilizer base.

The grease and scum from the intermediate and final tanks is disposed of by lagooning, while the grease from the primary tank is sold to a rendering plant, for which the plant receives several thousand dollars a year. The best year netted better than $18,000.

From the primary settling tanks, the sewage flows by gravity to the mechanical flocculation tanks. Three units, each 33 ft. wide by 8 ft. liquid depth by 55 ft. long with motor-driven paddle-type agitators are there. These units provide a 45-minute detention at a 10 MGD rate.

From the flocculation units the sewage flows by gravity to intermediate settling tanks. These three settling units are 33 ft. wide by 8 ft. liquid depth by 110 ft. long equipped with sludge collectors, cross collectors, skimming and scum removal equipment. The weir length is 540 feet which at 10 MGD gives a rate over weirs of .019 million gallons per foot per day. The settling rate at 10 MGD is equal to 920 gallons per square foot of tank area. The detention period at 10 MGD is 1.5 hours.

From the intermediate settling tanks the sewage flows by gravity to Wet Well No. 2 and thence to intermediate sewage pumps -- two 10 MGD and one 5 MGD motor-driven horizontal pumps located below sewage level for continuous prime. All effluent of intermediate settling tanks over a range of 10 MGD can be pumped to a storage unit and applied to filters when the normal flow falls below a 10 MGD rate, thereby leveling off the plant flows over a 24-hour period. This is done when the conditions of the Mississippi River require additional treatment.

From Wet Well No. 2 the sewage is normally pumped by the above-mentioned pumps to the six primary filters. Each filter is 113 ft. inside of wall diameter with average rock depth of 6 ft., with a total rock area of 1.26 acres. The filters are arranged for back-washing.

Back-washing is accomplished by flowing approximately 450,000 gallons per filter of plant effluent upward into the filter from the bottom through the tile channels, along with simultaneous air wash. The waste back-wash water flows by gravity to the lower section of the storage unit and at night it is fed back into the plant along with the raw sewage. Back-washing has been done at intervals of from two to four weeks, depending on operating conditions.

The filters are not equipped with dosing tanks. Intermediate effluent is pumped directly to the rotary distributors.

Since back-washing of trickling filters is not a common procedure, it may be worth-while to discuss this process in more detail. For back-washing, as previously stated, 450,000 gallons of plant effluent is used for each filter. The wash water is not pumped directly into the filters, but instead is pumped to an elevated storage tank of 475,000-gallon capacity.

During back-washing the elevated tank is allowed to empty very rapidly through a 48-in. concrete conduit. The flow through the filters is at the rate of 15,000 gallons per minute, with a hydrostatic pressure at the base of the filter of 6.3 to 4.7 pounds. To aid in back-washing, a grid of air lines with orifices spaced 18 inches from center to center, was placed 7 inches above the bottom of the filter rock. To furnish air for this aeration system a blower delivering 6,500 cubic feet per minute is used. It delivers 3 pounds pressure at the discharge of the blower.

From the filters the sewage flows by gravity to final settling tanks, which are the same design as intermediate tanks, with the same sludge and scum collection and detention period (1.5 hours).

The sewage flows by gravity to the Mississippi River, or during high river stage to Wet Well No. 3, and thence to the river by pumping. This pumping adds considerably to the cost of treatment, but could not be avoided due to the relative elevations of the intercepting sewer and treatment plant. Chlorination is provided for with two machines, both manual, which can delivery chlorine at three points in the plant.

The average sewage flow for killing days (killing days are the days the packing plants are killing) during the past five years was 11,246,000 gallons per day. On Sundays and holidays it was only 6,590,000 per day. Weir studies indicated that better than 90 percent of the sewage flow on week days is industrial waste from Armour and Company, Swift and Company, and the Stockyards Company, the city domestic flow contributing less than 10 percent of the total flow.

All data subsequently reported is based on 24-hourly samples composited according to flow for the raw sewage and for the primary, intermediate, and plant effluent; and 12 bi-hourly samples also composited according to flow.

BOD

On killing days, the BOD of the raw sewage for the last ten years averaged 1,252 ppm, with a peak monthly average of 2,159 and a low of 756 ppm.

The BOD of the plant effluent for week days has averaged 449 ppm. This represents an overall reduction of 64.1 percent. Using only killing days, with an average flow of 11.25 MGD, the average daily removal of BOD was 75,400 pounds. Because of the heavy loading of paunch manure, it is possible to remove 15.2 percent of the raw sewage BOD in the grit chambers alone, and an additional 23.9 percent in the mechanical flocculators and primary settling tanks. Thus approximately 61.0 percent of the total reduction of 64.1 percent is accomplished by primary sedimentation. The trickling filters remove more BOD than might be expected, for the sewage going on the filters has an average BOD of 762 ppm. Of this 313 ppm are removed by the filters and the final settling tanks, which is 40.0 percent of the applied BOD.

Settleable Solids

As might well be expected of a plant with trickling filters, practically all the settleable solids are removed. Of the raw average of 18.5 ml/l of settleable solids, 17.7 ml/l are removed. This represents an overall removal of 95.8 percent.

Suspended Solids

Of the 991 ppm of suspended solids entering the plant, 862 ppm were removed. This gave an overall removal of 86.8 percent. Of this 37.0 percent was removed by the grit chambers and 43.4 percent by the primary sedimentation tanks, with 19.6 percent removed by the trickling filter and final sedimentation tanks.

The high percentage of removal by the grit chambers and primary sedimentation tanks is attributed to the nature of the sewage. The raw sewage has enough heavy organic material in suspension so that when it becomes quiescent in the grit chambers and in the primary sedimentation tanks this material quickly settles out, removing the suspended solids nearly as effectively as a chemically produced floc.

The operation and maintenance of the plant is under the direction of a three-man sewage disposal commission created by ordinance and appointed by the City Council. The annual operating budget is approximately $105,000. 90 percent of this is paid by the industries and the remaining 10 percent by the city. This is in accord with a 15-year agreement entered into by the industries and the city. The city's 10 percent is raised by a sewage rental charge, which originally was established as 30 persent of the amount of water bills for the quarter ending March 31st of the previous year; this 30 percent has since been reduced to a 15 percent charge. The operating personnel consists of an operator and helper on each of three shifts and two relief men, three laborers on the day shift, a chemist and a superintendent.

Every precaution is taken to safeguard the health and life of plant personnel. All have been inoculated against typhoid and paratyphoid A and B. Safety equipment is provided in the nature of carbon monoxide detector, hydrogen sulfide detector, Wolf Safety Lamp for detection of oxygen deficiency, two all-purpose gas masks, one chlorine gas mask, safety helmets, dust respirators, goggles, safety harness (for lowering men into hazardous areas) and complete first-aid equipment.

ANALYTICAL DATA

AVERAGE OF THE TEN YEAR PERIOD ENDING MARCH 31, 1961

(Killing Days)

	Raw Sewage	Primary Effluent	Intermediate Effluent	Final Effluent	% Reduction
Suspended Solids (P.P.M.)	991	673	296	129	86.8%
Settleable Solids Ml/L	18.5	7.9	2.2	.79	95.8%
5 Day B.O.D. P.P.M.	1252	1061	762	449	64.1%
POPULATION EQUIVALENT		653,000	Flow M. G. D.		11.25

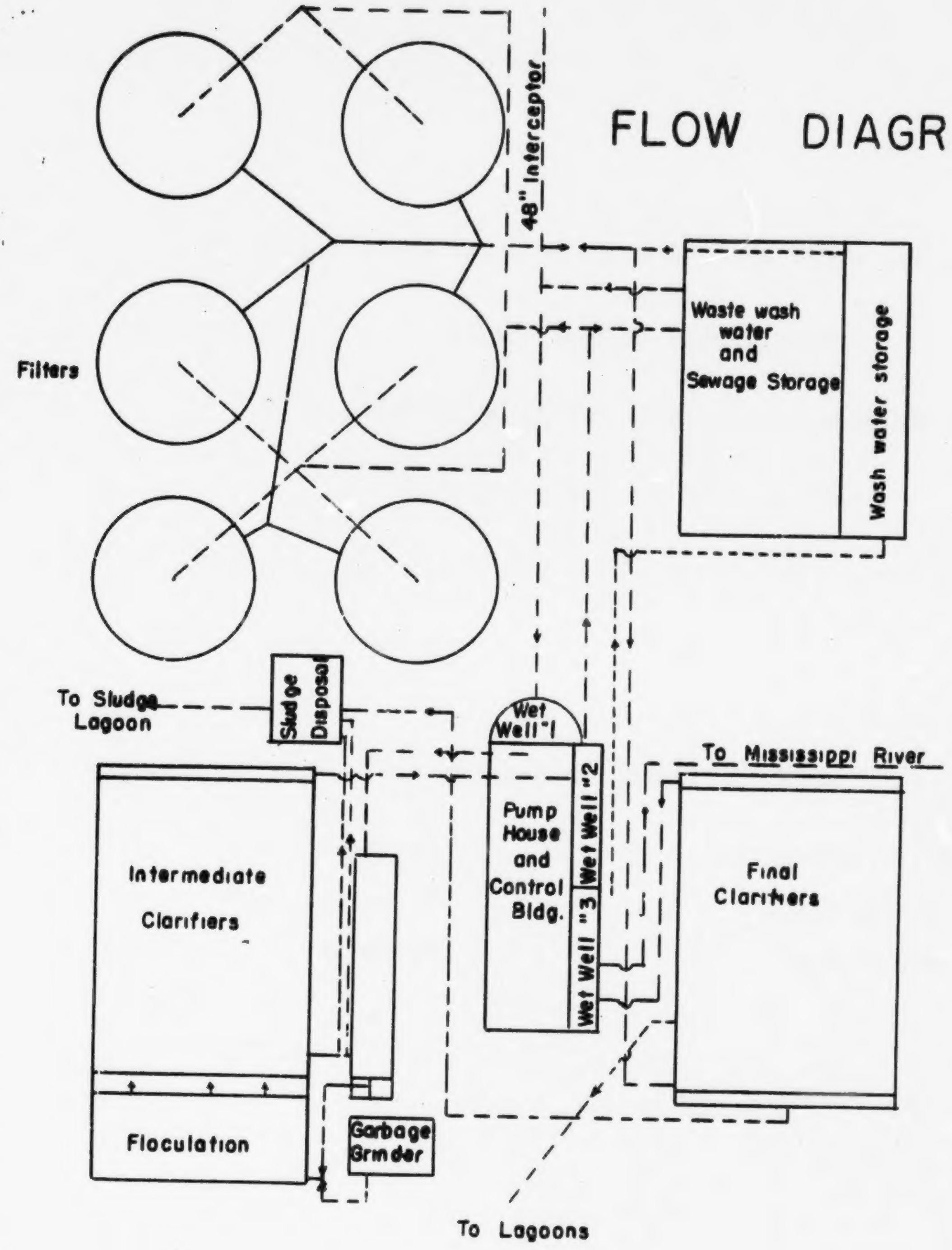
ANALYTICAL DATA

AVERAGE OF THE TEN YEAR PERIOD ENDING MARCH 31, 1961

(SUNDAYS & HOLIDAYS)

	Raw Sewage	Primary Effluent	Intermediate Effluent	Final Effluent	% Reduction
Suspended Solids (P.P.M.)	165	137	74	50	69.7%
Settleable Solids Ml/L	2.68	1.28	.21	.09	96.5%
5 Day B.O.D. P.P.M.	202	181	150	110	45.4%
POPULATION EQUIVALENT		74,000	Flow M.G.D.		6.59

FLOW DIAGRAM



— — — Sewage
--------- Backwash
———— Lines used for both sewage and backwash
— - — Sludge

Sewage Treatment Plant
South St. Paul, Minnesota

TWENTY-THIRD ANNUAL REPORT

SEWAGE DISPOSAL COMMISSION, SOUTH SAINT PAUL, MINN.

APRIL 1, 1962 to MARCH 31, 1963

SEWAGE DISPOSAL COMMISSION

Mr. R. B. McCreight	President
Mr. Joseph Bartl	Vice-President
Mr. Henry Zika	Secretary

* * * * * * *

FINANCIAL STATEMENT

FISCAL YEAR ENDING MARCH 31, 1963

SEWAGE DISPOSAL COMMISSION

SOUTH SAINT PAUL, MINN.

FOR OPERATING AND MAINTENANCE SEWAGE TREATMENT PLANT

BALANCE ON HAND MARCH 31, 1962		$ 11,012.15
REVENUE		
Collections	$105,978.43	
Sales (grease, sludge, scrap)	7,960.50	
Refunds & Reimbursements	62.39	
	$114,001.32	
		$ 114,001.32
		$ 125,013.47
EXPENDITURES		
Salaries	$ 84,454.06	
Light & Power	21,087.32	
Repairs & Replacements	10,398.39	
Material & Supplies	1,841.60	
Insurance	1,448.42	
Gas - Grease - Oil	54.78	
Other Operative Expenses	1,995.83	
Telephone	237.75	
Other Administrative Exp.	1,059.51	
	$122,598.86	
Total Expenditures		$ 122,598.86
Balance on Hand March 31, 1963		$ 2,414.61

PLANT OPERATION

5 DAY B.O.D. IN P.P.M. FOR WEEK DAYS

AVERAGES OF 24 HOUR COMPOSITES

1962	RAW	PRIMARY	INTER.	FINAL	% REDUCTION
APRIL	1016	851	671	419	59.2
MAY	1127	1039	655	370	67.2
JUNE	1317	1118	729	372	71.8
JULY	1313	1143	723	386	70.6
AUG.	1374	1204	778	413	69.9
SEPT.	1226	1115	719	409	66.6
OCT.	1297	1184	893	476	63.3
NOV.	1496	1217	792	491	67.3
DEC.	1617	1519	983	611	62.3
JAN. '63	1573	1463	974	616	60.8
FEB.	1432	1276	930	670	53.0
MAR	1445	1328	870	655	54.6
YEARLY AVERAGE					
	1356	1206	809	491	63.8

PLANT OPERATION

SUSPENDED SOLIDS IN P.P.M. WEEK DAYS

1962	RAW	PRIMARY	INTER.	FINAL	% REDUCTION
APRIL	710	554	211	107	85.1
MAY	821	633	204	74	91.0
JUNE	871	641	254	116	86.5
JULY	877	653	217	106	83.9
AUG.	836	657	266	109	86.8
SEPT.	834	625	245	82	90.2
OCT.	977	726	419	156	83.9
NOV.	1046	849	382	157	85.0
DEC.	979	729	394	164	83.3
JAN. '63	1106	719	369	184	83.3
FEB.	855	661	371	194	77.8
MAR.	980	735	351	182	81.6
YEARLY AVERAGE .					
	908	684	307	136	85.1

PLANT OPERATION

SETTLEABLE SOLIDS ML/L. FOR WEEK DAYS

AVERAGES OF 24 HOUR COMPOSITES

1962	RAW	PRIMARY	INTER.	FINAL	% REDUCTION
APRIL	13.8	5.7	.92	.77	94.4
MAY	14.7	7.1	.89	.69	95.2
JUNE	14.6	7.6	1.33	.61	95.7
JULY	15.6	7.1	.95	.47	97.0
AUG.	14.9	6.3	1.66	.78	94.6
SEPT.	14.6	6.6	1.16	.69	95.4
OCT.	16.6	8.2	3.72	1.43	91.4
NOV.	18.1	9.5	3.08	1.16	93.6
DEC.	15.6	8.1	3.29	1.00	93.5
JAN. '63	16.4	8.1	3.06	1.81	88.8
FEB.	15.6	9.1	1.90	1.78	88.5
MAR.	16.1	8.1	1.48	.81	95.0
YEARLY AVERAGE					
	15.5	7.6	1.95	1.00	93.6

PLANT OPERATION

TOTAL SOLIDS IN P.P.M. FOR WEEK DAYS

AVERAGES OF 24 HOUR COMPOSITES

1962	RAW	PRIMARY	INTER.	FINAL	REMOVAL
APRIL	2546	2230	2029	1924	622
MAY	2686	2426	2030	1826	860
JUNE	2771	2507	2241	1939	832
JULY	2904	2616	2253	2002	902
AUG.	2799	2560	2202	1909	890
SEPT.	2644	2392	2058	1779	865
OCT.	2830	2552	2252	1902	928
NOV.	2969	2651	2238	1896	1073
DEC.	2907	2691	2305	2066	841
JAN. '63	2970	2546	2246	1983	987
FEB.	2773	2505	2192	1969	804
MAR.	2822	2526	1977	1919	903
YEARLY AVERAGE -					
	2802	2517	2169	1926	876

SOUTH ST.PAUL SEWAGE TREATMENT PLANT

B.O.D.

YEARLY AVERAGES WEEK DAYS

YEAR	RAW	PRIMARY	INTER.	FINAL	% REDUCTION
1953-1954	1077	936	674	433	59.8
1954-1955	1108	930	735	412	62.8
1955-1956	1364	1140	912	521	61.3
1956-1957	1127	953	724	432	61.6
1957-1958	1286	1048	779	509	60.4
1958-1959	1294	1102	785	442	65.8
1959-1960	1431	1245	806	462	67.7
1960-1961	1423	1226	843	465	67.2
1961-1962	1337	1189	823	432	67.7
1962-1963	1356	1206	809	491	63.8
10 year avg.	1280	1097	789	460	63.9

SOUTH ST. PAUL SEWAGE TREATMENT PLANT

SUSPENDED SOLIDS

YEARLY AVERAGES FOR WEEK DAYS

YEAR	RAW	PRIMARY	INTER.	FINAL	% REDUCTION
1953-1954	1041	691	278	141	86.4
1954-1955	1016	686	350	139	86.3
1955-1956	1298	859	437	172	87.0
1956-1957	1096	768	325	135	87.1
1957-1958	957	691	299	146	84.7
1958-1959	1004	637	282	116	88.3
1959-1960	898	715	258	138	86.2
1960-1961	910	681	295	118	87.1
1961-1962	896	643	289	114	87.3
1962-1963	908	684	307	136	85.1
10 year average	1011	707	312	135	86.6

SOUTH ST. PAUL SEWAGE TREATMENT PLANT

SETTLEABLE SOLIDS ML/L

YEARLY AVERAGES FOR WEEK DAYS

YEAR	RAW	PRIMARY	INTER.	FINAL	% REDUCTION
1953-1954	19.8	8.1	1.6	.47	97.6
195401955	19.5	7.1	4.1	.69	96.3
1955-1956	22.8	10.4	4.7	1.35	94.2
1956-1957	19.1	8.2	1.8	.76	96.4
1957-1958	18.4	7.7	2.0	.96	94.8
1958-1959	18.2	7.4	1.6	.90	95.1
1959-1960	18.7	9.3	2.3	1.14	93.9
1960-1961	17.0	7.9	1.7	.96	94.4
1961-1962	15.9	7.0	1.5	.86	94.4
1962-1963	15.5	7.6	1.9	1.00	93.6
10 year avg.	18.5	8.1	2.3	.91	95.1

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POPULATION EQUIVALENTS

WEEK DAYS

	FLOW M.G.D. AVERAGE	B.O.D. RAW SEWAGE AVG.	POP. EQUIVALENTS AVERAGE
APRIL '62	12.36	1016	582,000
MAY	12.70	1127	663,000
JUNE	11.96	1317	727,000
JULY	12.43	1313	757,000
AUG.	12.80	1374	813,000
SEPT.	13.13	1226	745,000
OCT.	13.15	1297	879,000
NOV.	12.90	1496	893,000
DEC.	12.70	1617	947,000
JAN. '63	13.84	1573	1,008,000
FEB.	13.83	1432	918,000
MAR.	14.70	1445	984,000
YEARLY AVG.	13.04	1356	812,000

SUNDAYS & HOLIDAYS

YEARLY AVG	6.94	168	54,000

Based on standards of 0.18 pounds of 5 day B.O.D. per capita

SOUTH ST. PAUL SEWAGE TREATMENT PLANT

COST ANALYSIS FOR YEAR 1962-63

	MONTHLY COST OF OPERATION	M.G. OF FLOW	COST PER M.G.	COST OF ELECTRICTY PER M.G.
APRIL 1962	$ 11,946.54	319	$ 37.80	$ 5.24
MAY	10,988.50	338	32.50	5.41
JUNE	10,370.40	308	34.20	3.32
JULY	10,073.10	330	30.40	5.28
AUG.	10,009.03	350	28.60	5.62
SEPT.	8,965.88	328	27.30	4.93
OCT.	10,745.13	362	29770	4.47
NOV.	11,026.97	332	33.20	5.11
DEC.	7,641.01	328	23.30	5.04
JAN.1963	10,640.72	365	29.20	4.76
FEB.	10,010.29	340	29.50	5.73
MAR.	9,951.20	394	25.20	4.21
TOTAL	$ 122,568.86	4,094	$ 29.90	$ 5.02

COMPARATIVE COST DATA

LOCATION OF PLANT	YEAR	AVG. FLOW M.G.D.	COST PER M.G. *	COST PER TON B.O.D. REM.	COST PER TON SUSP. SOLIDS REM.
MIDDLESEX CO. N.J.	1960	45.6	$ 57.29	$ 225.50**	$ 76.60
YONKERS, N.Y.	1960	59.2	40.00	320.00**	117.30
RACINE, WIS.	1960	17.3	23.62	113.70	67.80
GARY, IND.	1961	30.1	26.76	31.60	13.15
JACKSON, MICH.	1960	10.3	60.62	134.00	82.30
TOLEDO, OHIO	1960	53.5	33.74	81.90	48.60
DISTRICT OF COLUMBIA	1960	171.6	22.68	53.80	49.20
GRAND RAPIDS, MICH.	1960	31.0	19.33	63.30	48.90
WINNIPEG, CANADA	1960	39.8	23.00	35.15	29.80
BOISE, IDAHO	1960	6.2	26.26	75.00	48.00
AVERAGE OF THE ABOVE 10 PLANTS ****		46.5	$ 24.37	$ 73.78	57.16
SOUTH ST PAUL, MINN.	1962-63	11.21	$ 29.90	$ 10.90	$ 12.20

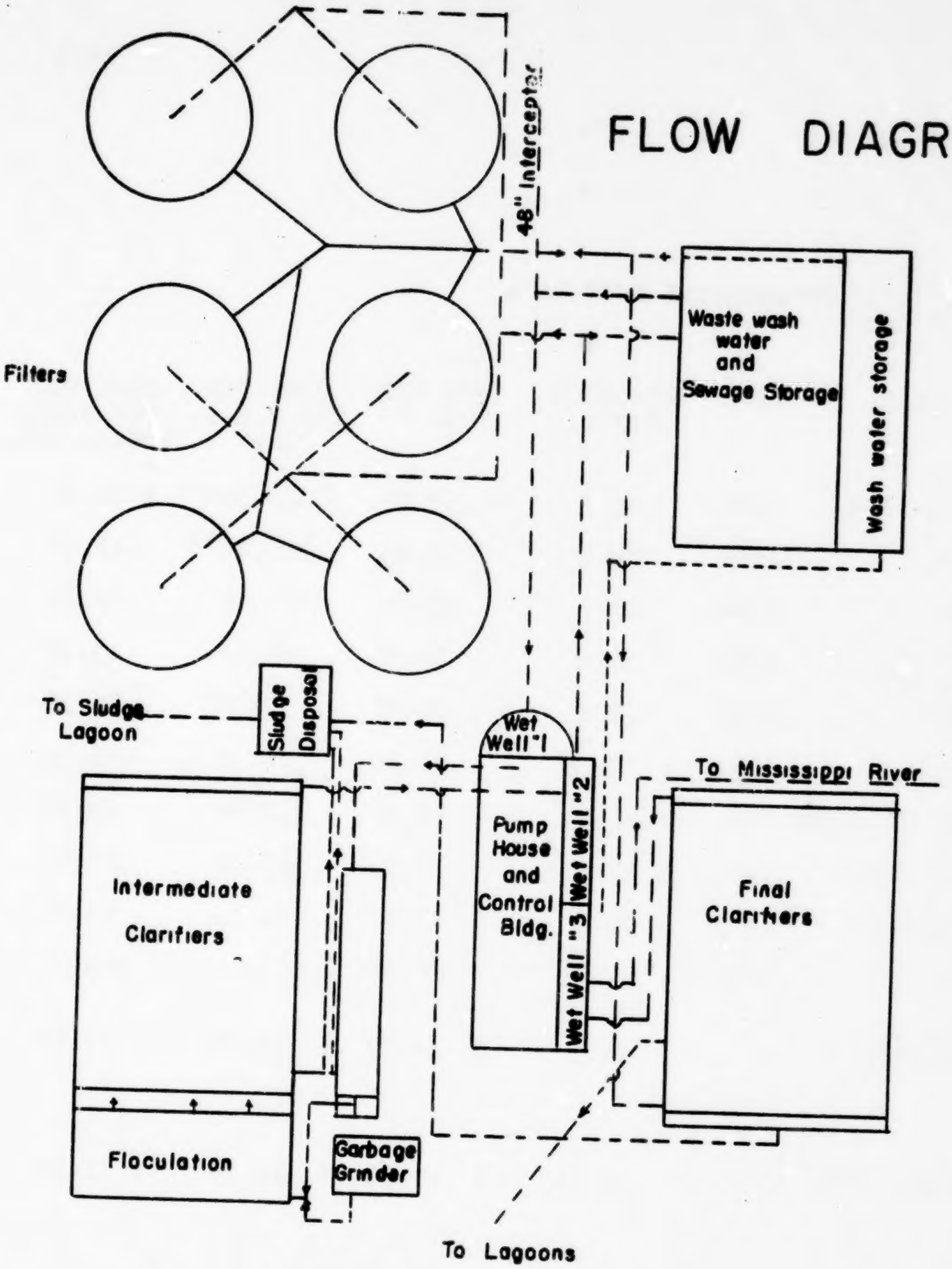
*OPERATION

** Not in average.

***South St. paul averages are for all days.

**** The cost data for the 10 cities above was taken from the Journal of Water pollution Control Federation and annual reports.

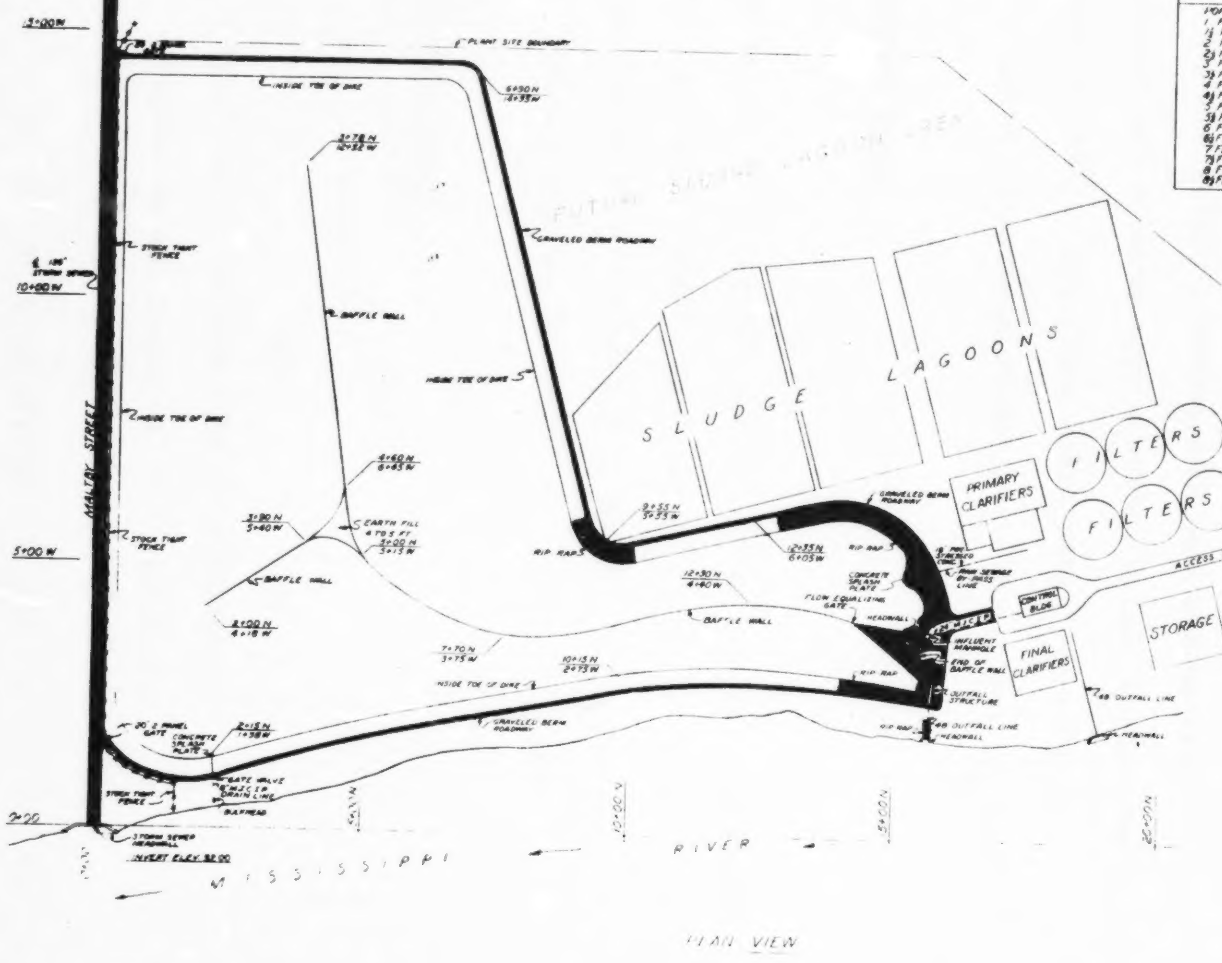
FLOW DIAGRAM



Sewage Treatment Plant
South St. Paul, Minnesota

— — — Sewage
------------ Backwash
———— Lines used for both sewage and backwash
—·—·— Sludge

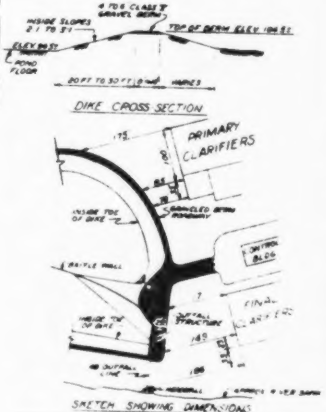
1481



PLAN VIEW

POND INFORMATION			
OPERATING LEVEL	APPROX POND AREA IN ACRES	APPROX VOLUME IN CUBIC FEET	APPROX. VOLUME IN GALLONS
POND FLOOR	24.6	—	—
1 FOOT	25.0	1,080,000	8,100,000
1½ FEET	25.2	1,620,950	12,157,100
2 FEET	25.3	2,270,850	16,281,400
2½ FEET	25.5	2,824,750	20,435,800
3 FEET	25.7	3,392,600	24,519,500
3½ FEET	25.9	3,944,400	28,833,000
4 FEET	26.1	4,510,200	33,075,500
4½ FEET	26.3	5,079,950	37,349,600
5 FEET	26.4	5,653,650	41,652,400
5½ FEET	26.6	6,231,250	45,984,400
6 FEET	26.8	6,812,900	50,346,800
6½ FEET	27.0	7,398,500	54,738,800
7 FEET	27.2	7,988,050	59,160,400
7½ FEET	27.3	8,581,600	63,612,000
8 FEET	27.5	9,179,100	68,093,300
8½ FEET	27.7	9,780,550	72,804,100

NOTE:
POND AREAS ARE ROUNDED OFF TO THE CLOSEST ONE TENTH ACRE.
VOLUMES WERE COMPUTED BY AVERAGING THE POND FLOOR & OPERATING LEVEL AREAS.
VOLUMES ARE ROUNDED OFF TO C[illegible]EST 100 GALLONS.



SKETCH SHOWING DIMENSIONS

AS BUILT PLAN VIEW
WASTE TREATMENT POND
SOUTH ST PAUL, MINNESOTA

COMSTOCK & DAVIS INC., CONSULTING ENGINEERS
1446 COUNTY RD "J"
MINNEAPOLIS, MINNESOTA

SCALE	1" = 100	REVISIONS
DATE	JAN 1963	
DESIGN	S B	
DRAWN	S B	
APPROVED	E V C	SHEET 1 OF 7

J. P. Badalich

HISTORY OF THE SOUTH ST. PAUL ANAEROBIC WASTE STABILIZATION POND TO NOVEMBER 1, 1963

GLASS CYLINDER TESTS

From September 19, 1958, to October 6, 1958, tests were conducted by filling 1000 Ml. glass graduates with plant effluent. Tests indicated that with a 5-day detention period up to 63 percent of the BOD could be removed.

WOODEN BARREL TESTS

These tests were conducted from October 6, 1958, to January 16, 1959. The first tests were inconclusive as the barrel was covered with a copper screen which came in contact with the liquid. Copper sulphate formed which apparently controlled the algae, bacterial and protozoan growth. The copper screen was removed and the tests continued.

Results of this phase of the investigation indicate that a 3-day detention period would remove 53 percent of the BOD, while 8 to 10 days would remove up to

75 percent of the BOD in a normal plant effluent.

In addition to the BOD removal, two toxicity tests were taken. The first was conducted by placing minnows in a 50 percent solution of the barrel effluent. The minnows showed some ill effects but recovered when they were placed in clean water. The second test consisted of placing minnows in a 25 percent solution of the barrel effluent and showed no ill effects after 24 hours. All solutions were constantly aerated. Results of these tests indicated that the effluent, in reasonable quantities, would not have a toxic effect on fish life.

WASTE STABILIZATION POND

With the encouraging results obtained by the above-mentioned tests, it was deemed advisable to conduct further studies on a larger scale. The top compartment of the waste wash water storage reservoir was used for the study which took place from July 23, 1959, to August 28, 1959, and from October 18, 1959, to November 5, 1959.

This pilot pond had a capacity of 450,000 gallons, 12,000 square feet of surface area, and was operated at a depth of approximately 5 feet. A pump, calibrated at 158 gpm, was used to pump the plant effluent into the pond.

In an attempt to duplicate heavy loading periods, the effluent was pumped into the ponds (at a constant rate) from 11 a.m. to 9 p.m. during "kill" days (Monday through Friday). No plant effluent was pumped into the pond from 9 p.m. to 11 a.m. on "kill" days nor was any pumping done on Saturdays, Sundays or holidays.

The pond was "seeded" with 4 gallons of liquid from Green Lake to start algae growth. Samples were taken of the pond influent and pond effluent every 2 hours, composites made and analyzed. Three series of tests were conducted. The first was made by pumping the final plant effluent into the pond; the second was made using the intermediate tank effluent (by-passing the filters and final clarifiers); and the third duplicated the second, but was conducted in cold weather and without a "seeding" period. Results of these tests indicate:

(1) Approximately 50 percent of the plant effluent BOD could be removed in 5 days' detention.

(2) Approximately 58 percent of the intermediate tank effluent BOD could be removed in 5 days.

(3) Approximately 48 percent of the intermediate BOD could be removed in cold

weather in 5 days without seeding or conditioning the pond.

It can readily be seen that the results obtained by these studies indicate a BOD removal of approximately 50 percent in the present sewage treatment plant effluent could be expected with the installation of a stabilization pond following the present existing treatment process. In the latter part of 1961, this report and study was presented to the South St. Paul Sewage Disposal Commission and the City Council and received very favorably.

Therefore, on November 6, 1961, the City of South St. Paul engaged the consulting engineering firm of Comstock & Davis to prepare a preliminary plan and report on a proposed sewage stabilization pond.

On January 22, 1962, the consulting engineers completed their report and said report was accepted by the South St. Paul City Council and referred to the Minnesota State Board of Health for their approval and recommendation.

On February 2, 1962, this preliminary report and plan was recommended for construction by Mr. Lyle H. Smith, Chief, Section of Water Pollution Control for the State Board of Health.

Therefore, on February 5, 1962, at their regular council meeting, the City Council of South St. Paul again engaged the firm of Comstock & Davis to prepare final plans and specifications for this stabilization pond project.

On April 16, 1962, the consulting engineers completed their final plans and specifications and these plans and specifications were accepted by the City Council and the project advertised for bids.

On May 7, 1962, bids were received and the job of constructing this sewage stabilization pond was awarded to the Park Construction Company of Minneapolis for a lump sum of $129,500.

The completion of this project was scheduled for August 1, 1962, but due to high river waters during the late spring and summer of that year and the seemingly never-ending rains, the project was not completed until December 1962.

The pond, as built, is generally L-shaped with a perimeter of little over one mile, and with an area of 26.4 to 27.7 acres, depending on operating depth. The pond is divided by a 10-foot baffle wall so that the flow in the pond is directed away from the main part of the plant for approximately half a mile, and then returned to the outlet structure near the main part of the plant. This outlet structure contains a Parshall flume for measuring the pond effluent, and adjustable weirs for regulating the pond level from 5 feet to 8-½ feet. At 8-½ feet the pond will hold approximately 72,604,000 gallons of sewage. (See as built planview).

BREAK-IN PHASE

At 2:05 p.m., February 7, 1963, which happened to be Thursday, the first plant effluent was pumped into the pond. At first only daytime pumping was carried out and not on Saturday or Sunday. The result was that the pond filled very slowly and the first time the water built up high enough to produce an effluent was on February 19th at 3:30 p.m.

At this time the effluent water temperature was 36°F with an influent temperature of 73°F.

On February 20th the coldest weather of the winter occurred. The wind chill was reported from -45°F to -60°F, with an actual temperature of -19°F. This resulted in forming an ice cover on one-half to two-thirds of the total pond area. By the week-end, February 23-24, the ice was thick enough on the effluent end of the pond to support a man.

However, the icing cover did not cause too much trouble, and it is felt that had the pond bottom been free of ice and frozen dirt, and had a continuous pumping schedule been maintained, considerably less ice would have formed at the effluent end of the pond. Even under these adverse conditions the BOD removal by the pond was about 38.5 percent based on influent to effluent with no consideration of flow. (See table.) During the latter part of February the pond was operated with a weir gate and the aeration caused by dropping over the gate resulted in considerable foam collecting in the river which froze in mounds 2 to 3 feet high.

By March 2nd all the ice on the pond was gone and another problem appeared. A considerable leak in the dike on the river side of the pond near the outfall structure was discovered. About this time the first chloroplastic protozoans and algae were noted, but the operation of the pond had to be discontinued to repair the dike. After considerable study it was decided the leak might best be stopped by laying a clay blanket on the inside of the dike. By March 29th an 8-inch thick compacted clay blanket was in place, protected by a compacted clay key 1 to 1-½ feet thick at the toe of the slope. This blanket extended along the east dike from the outfall structure for a distance of some 500 feet. The next day the pond was again put in service. The blanket was very effective and no further leaks occurred in this area. It might be stated here that before the clay blanket was decided on as the best method of sealing, several so-called experts on soil sealing were consulted. Most of these experts turned out to be sales engineers. They came up with all kinds of fancy ideas, all of which would have cost several times what the clay blanket cost, and none of them would guarantee their work unconditionally. By April 4th additional leaks on the southwest corner of the pond and along Maltby Street sewer fill were discovered, and we also found that there was considerable infiltration into the Maltby storm sewer. Our City Engineer, John Badalich, was concerned lest this infiltration into the sewer might damage it by washing the sand and gravel fill under the sewer into itself and out to the river with a subsequent settling throwing the sewer out of line. Based on our previous good results, a similar clay blanket and key was plased the entire 1,300 feet along the Maltby sewer and up some 500 feet along the west side of the pond. This so effectively sealed the bank of the sewer that the sewer actually dried up with not even a trickle of water at its mouth during dry weather.

OPERATION

On May 20, 1963, the pond was again being filled, but it was not until the latter part of July that relatively uniform operation was achieved.

From Table No. 2 one notes that the average raw sewage flow at the South St. Paul Sewage Treatment Plant on killing days at the Packing Plants for the months of July, August, September and October, 1963, was 13,810,000 gallons a day. For all practical purposes the influent to the pond was the same as the raw sewage flow. It is true that a small amount of flow is lost in the primary plant due to the sludge pumping and evaporation, but this is insignificant. Therefore, the pond influent is considered the same as the raw sewage flow, or 13,810,000 gallons per day.

The third column of that table indicates the pond effluent flow to be 8,720,000 gallons. This represents a loss of volume of 5,090,000 gallons, or approximately 37 percent of the original volume. Of the water that leaches into the ground some of it eventually reaches the Mississippi River. However, we feel it would be safe to assume that nearly 100 percent of the suspended solids and practically all of the BOD have been filtered out in traveling in the soil 50 to several hundred feet. Therefore, if one converts the BOD to pounds per day one arrives at 57,122 pounds for the influent and 18,025 pounds per day for the effluent.

This represents an overall removal by the pond, as far as the Mississippi River is concerned, of 68.5 percent of the BOD; whereas, if one compared the BOD in mg/l in the influent and effluent to one another one would get a little less than 50 percent or 49.2 percent, to be exact. This compares very favorably with our original estimate of a possible 50 percent removal. In the original studies there was no leaching, and evaporation was not considered.

For the three months reported, without the use of the pond, the overall plant removal would have been 62.8 percent, but with the additional removal by the pond it actually reached 88.2 percent.

It may be of interest to note that the loading of BOD entering the pond was in excess of 2,000 pounds per acre per day with an average of approximately 8.2 pounds of BOD per 1,000 cubic feet.

The State Board of Health, Division of Environmental Sanitation, did some studies on the pond. Their studies indicated approximately 53 percent BOD removal based on influent to effluent, not considering flow, which was somewhat better than the results I obtained for the same days.

Turning to Table No. 3 one sees that the removal of suspended solids, as might be expected, was even better than for BOD. It might be pointed out here that the BOD and suspended solids samples of the pond were not filtered, as is done by some persons testing pond effluents. The suspended solids removed by the pond was 74.6 percent, making an overall removal by the plant of 94.9 percent, as compared to 82.2 percent for the original plant. The pH of the pond effluent appears to be in the neighborhood of 7.3, when the pond is operating normally.

In studying the effectiveness of letting the pond drain down on week-ends without adding any normal plant effluent, as operated in October, with the closing of the gates on week-ends but with no addition of normal plant effluent, as operated in September, one finds the following results: For four typical Sundays in September -- when the gates were closed and there were no additions -- the average pounds of BOD leaving the plant on Sundays was 7,500 pounds. In October -- with the pond effluent gates open and no additions -- the average pounds of BOD of the combined effluents (normal plant and pond) were 11,200 pounds BOD. However, this is not the whole picture, for in September the average killing day flow for the pond was a little over 2,000,000 gallons more per day than similar days in October. This produced a load to the river of 4,9[illegible] BOD more per killing day, and since there are five killing days per week it amounts to approximately 21,200 pounds more BOD. That is the difference between 24,900 and 3,700 (difference between plant effluent BOD on Sunday for September and October) which equals 21,200 pounds BOD added due to the higher flows on the average killing days. It is true the flow from the pond on Saturday should be subtracted from this -- 21,200 pounds BOD minus 7,800 pounds BOD equals 13,400 pounds BOD, which was the overall savings. This amounts to approximately 15 percent reduction in the load to the river.

The pond method of tertiary treatment, at least for industrial sewage treatment plants, has two other very distinct advantages over second stage filtration besides doing a better job than could be expected from second stage filtration. In the first place, it acts as a daily and a weekly equalizer of the plant effluent flow as well as of the plant effluent loading in BOD and suspended solids on the receiving body of water.

As can be seen from Graph No. 1, the loading of settleable solids coming into the plant for an average 24-hour period fluctuates over an almost unbelievable range. The graph was made from the averages of the 24-hour data from two typical Wednesdays in each of the months of July, August, September and October of 1963. As might be expected, the low flow for the 24 hours is less than 50 percent of the peak flow, and the low settleable solids also occur at the time of the low flow. Therefore, if one multiplies the flow as measured in thousands of gallon per hour by the ml of settleable solids one gets a relative load value per hour. This shows that the peak loading coming into the plant is approximately 39 times as great as the low loading. Obviously, one cannot say that the loading in BOD leaving the plant varies over the same considerable ranges, for any plant will take out more of a heavy loading than a light, but it is at once apparent that the loading of BOD leaving the plant will be several times greater in the daytime than the loading leaving the plant at night. However, this is not true from the pond. Tests of nighttime BOD and daytime BOD show them to be nearly the same while the flow varies only slightly. It would be interesting to run BOD's on the pond influent and effluent every two hours for several days to see what these figures would actually be, but I have not had time to do this. It would be a good project for some graduate student.

In some small streams this leveling of the load might be a big factor in being able to keep a DO in the stream, and as was pointed out earlier, the pond can be used as a method of equalizing the day-to-day loading on the river by putting out a heavier loaded effluent during week-ends than would occur with conventional treatment, where the water is held in the plant for only a few hours.

The second advantage is that a plant equipped with a pond can hold from the receiving body of water the entire plant effluent for several hours, or even a few days in case of an emergency, at another plant on the same watercourse which has to bypass some or all of its flow.

Many persons are interested in odor from an anaerobic stabilization pond. Our experience is that the odor at the pond's edge is probably less than that from high-rate heavily loaded trickling filters, but definitely should not be considered odor-free, as some writers have suggested.

I am attaching to this paper a list of references. It should not be construed that this paper is based in any way on the references except that my original idea started from reading the article by Dr. Parker. They are placed there for your convenience in looking up material on both aerobic and anaerobic ponds. I have all of these references in my laboratory and they are available for your study in the laboratory. The references with an * in front of the number are also available in the Library of the State Board of Health.

J. P. Badalich

CONCLUSIONS FROM OUR EXPERIENCE TO DATE

1. An anaerobic waste stabilization pond as a tertiary treatment method following a first-stage trickling filter plant, providing the land is available at a reasonable price, will cost only a fraction of the cost of second-stage filters, and if the topography is favorable, even less.

2. That such a pond can be expected to remove better than 50 percent of the BOD and suspended solids put in it in less than five days' detention.

3. The operation of a waste stabilization pond will be only a fraction of the cost of filters and could be further reduced if the direction of flow could be obtained without a wooden baffle wall such as we have.

4. The pond as a tertiary method of treatment acts as an equalizer of the flow and of the load to the receiving body of water. This is very important for industrial waste treatment plants where the flow and load fluctuate from hour to hour and day to day over a wide range.

5. Such a plant can withhold its entire flow during emergencies at other plants.

6. Odor from an anaerobic plant is probably less than the odor from heavily loaded trickling filters,

but should be considered as a factor in its choice of use.

REFERENCES

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*2. Waste Stabilization Lagoons -- design, construction and operation practices among Missouri Basin States -- a committee report January 21, 1960, Department of Health, Education, and Welfare, U. S. Public Health Service, Region VI; obtained from:

Water Supply and Pollution Control Activities
2000 Federal Office Building
911 Walnut Street
Kansas City 6, Missouri

*3 Sewage Stabilization Ponds in Minnesota. March 1963, Minnesota Department of Health, Division of Environmental Sanitation, Section of Water Pollution Control, University Campus, Minneapolis 14, Minnesota.

Also reprint 5051 by Lyle H. Smith & Harvey G. Rodgers, May 1958. Also report on Investigations of Operation of Raw Sewage Stabilization Ponds, Alba[illegible],

Minnesota, June 16, 1955-June 2, 1956.

*4. Proceedings of Symposium on Waste Stabilization Lagoons. Kansas City, Missouri, August 1-5, 1960. Same address as 2 above.

5. Unique Wilson Waste Plant cuts BOD to Low Level. The National Provisioner, July 16, 1960. Volume 148 No. 3, pages 26, 27, 28 and 41.

6. Stabilization Ponds for Treatment of Sewage (practice in Western Canada) by Dr. D. R. Stanley of Stanley, Gimble, Rublin Ltd., Edmonton, Alberta.

*7. Operation Experience in Anaerobic Treatment of Packinghouse Wastes by A. J. Steffen, Wilson & Co., Inc., Chicago, Illinois.

8. A New Concept in Waste Disposal -- Wilson Treatment Plant, Albert Lea, Minnesota. Reprint from the Albert Lea Evening Tribune of Tuesday, June 7, 1960.

*9. Fast Action in Savannah's Lagoons, by C. C. Steadman, Dept. of Public Improvements. The American City, July 1960, pgs. 112 and 113.

*10. Lagoon Systems of Sewage Disposal by Pat Thomson. Water & Sewage Works Reference Number 1959 R-318, 319 and 320.

*11. Sewage Lagoons by Theodore Jaffe. Water and Sewage Works Reference Number 1958 R-277--R-280.

*12. Aerated Lagoon For Suburban Sewage Disposal by Ross E. McKinney & Howard Edde. University of Kansas, Lawrence, Kansas.

*13. Pond Treatment of Meat Packing Plant Wastes by F. W. Sollo, presented at the 15th Annual Purdue Industrial Waste Conference, May 1960. (Probably obtainable through Swift & Co., Chicago, Illinois.)

*14. Can You Use a Sewage Lagoon? By L. E. Webber. The American City, November 1959, pages 175-181.

*15. Municipal Sewage Lagoons by Donald E. French. Water & Sewage Works. Reference Data 1956, R-261-265.

*16. Sewage Lagoon With A Difference by W. A. Berschauer. March 1961, The American City, pages 89-90.

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GRAPH No. 1
RELATIVE LOAD PER HOUR OF SEWAGE STRENGTH ON KILLING DAYS

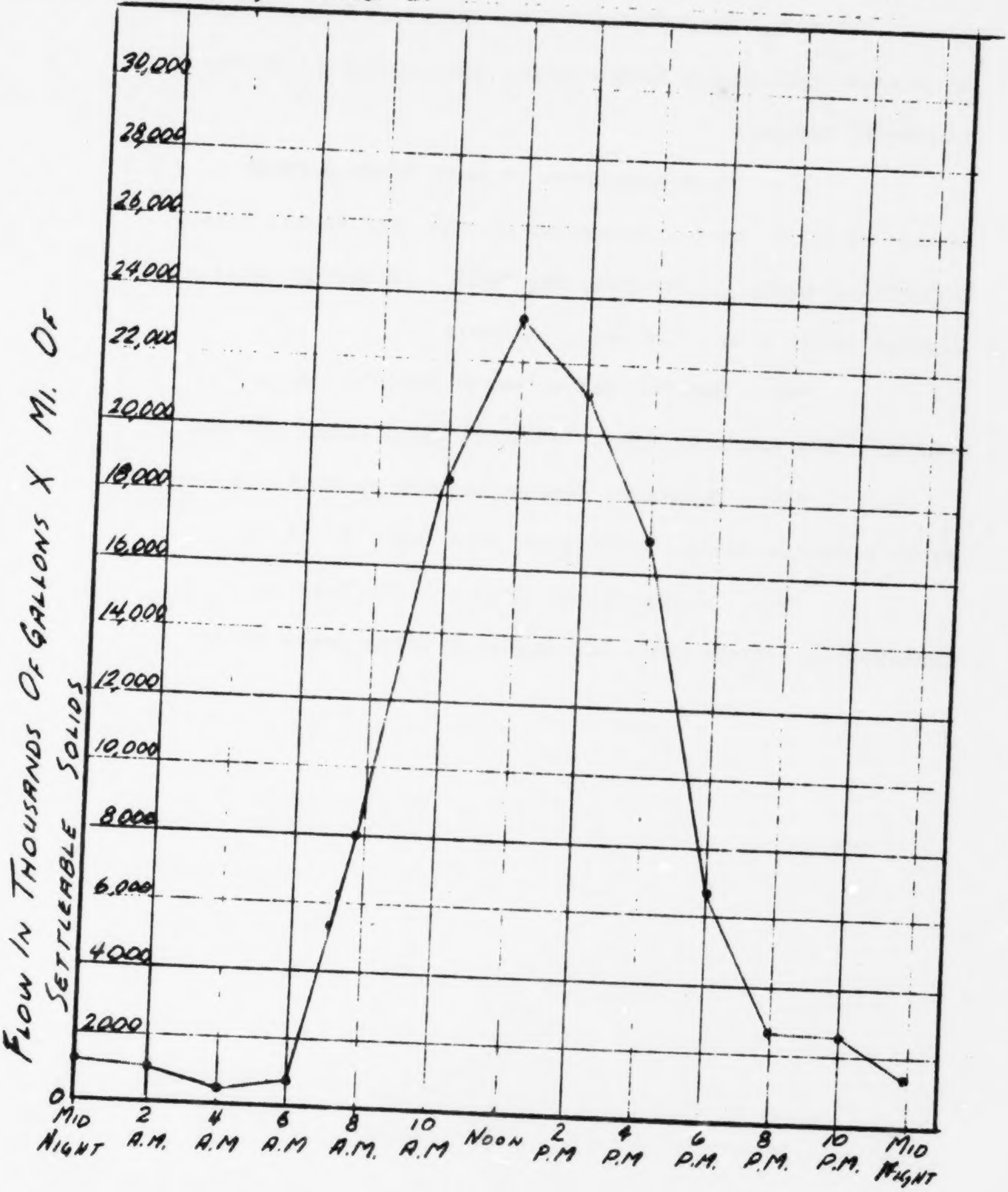

TABLE 1

DATA on Pond During Winter Operating Conditions

DATE	Raw S.	Normal Plant eff. Pond influent	Pond eff. Temp.	Pond eff.	% Removal of Pond	Total % Removal
2/19/63	1390	635		495	23.0	64.6
2/20/63	1490	595	35°F	456	23.5	69.6
2/22/63			38.5°F			
2/24/63	130	80	40°F	450		
Sunday			38°F			
2/26/63	1625	620	37.5°F	385	38.0	76.2
2/27/63	1240	600	39.5°F	380	37.0	69.2
2/28/63			42°F			
3/5/63	1510	725 Mar 1.	44°F	420	41.8	72.1
3/6/63	1575	595		450	24.3	71.6
		Normal Plant Removal				
Average	1470	660	55.0%	406	38.5	72.3%

WEATHER DURING THESE TESTS

DATE	HIGH	LOW	MEAN	WIND VELOCITY HIGHEST	DIRECTION	CLOUD COVER
2/16/63	25	14	20	11	S	90
17	34	10	22	10	SW	100
18	34	20	27	14	NNE	97
19	31	13	22	31	WNW	85
20	13	-13	0	35	NW	35
21	-1	-19	-10	28	NNW	5
22	14	-9	3	17	WNW	7
23	19	-8	6	12	NW	22
24	23	-7	8	17	NNE	33
25	10	-9	1	15	NNW	1
26	20	-11	5	18	S	10
27	24	-9	10	13	NNE	62
28	21	-8	7	13	SW	28
3/1/63	34	13	24			
2	40	24	32			
3	37	27	32			

1502

TABLE 2

South St. Paul Anaerobic Stabilization pond
B.O.D. Removal Efficiency Studies for Killing Days at the Packing Plants

Date	Raw Sewage & Pond Influent Flow M.G.D.	Pond Effluent Flow	Detention Based on Infl. / Effl.		B.O.D. in Pond Infl. Mg/l	Pounds B.O.B. in Influent: Per day	B.O.D. Loading #/Arce Per day	B.O.D. Loading #/1000 Cubic Ft.	B.O.D. in Effluent Mg/l	Pounds B.O.D. in Effluent	% Removal of Pounds B.O.D. in Pond	#B.O.D. in Raw Sewage	Over-all Plant Removal B.O.D. in %
*July/1963	14.48	9.02	Fluctuating		497	59,990	- - -	- - -	204	15,300	74.7	138,800	88.8
Aug./1963	13.63	8.80	3.8	5.7	411	46,700	1,750	6.9	205	15,200	67.4	137,200	88.6
Sept./1963	13.73	9.75	4.0	5.6	540	61,800	2,280	8.1	302	24,400	60.6	168,600	85.6
Oct./1963	13.41	7.31 **	3.4	6.3	538	60,000	2,260	9.7	282	17,200	71.3	169,400	89.8
Average	13.81	8.72	3.7	5.9	496	57,122	2,097	8.2	252	18,025	68.5	153,500	88.2

* Part of July
** Draining Pond on weekends but not adding Sewage

Table 3

South St. Paul Anaerobic Stabilization Pond
Suspended Solids Tests

Date	Influent Flow M.G.D.	Effluent Flow M.G.D.	Suspended Solid in Pond Influent Mg/1	Pounds S. Solid in Influent Per Day	Suspended Solids in Pond Effl. Mg/1	Pounds S. Solid in Effluent Per Day	% Removal in Pounds of S. Solid by Pond	# S. Solids in Raw Sewage	Overall Plant Removal S. Solid in %	Average Water Depth in Pond
July/1963	14.48	9.02	156	18,800	53	4,000	78.8	94,500	95.8	Flucuating
Aug./1963	13.63	8.80	146	16,600	57	4,200	73.8	96,500	95.6	5.9'
Sept./1963	13.73	9.75	179	20,200	58	4,700	76.6	111,000	95.7	6.7'
Oct./1963	13.41	7.31	162	18,100	94	5,700	68.4	115,200	92.7	5.5'
Average	13.81	8.72	161	18,425	65	4,650	74.6	104,300	94.9	

Mr. Chairman, I have submitted to the reporter an attached exhibit which we would like to have incorporated in the record.

MR. STEIN: Very well. That will be done.

MR. BADALICH: Thank you, Mr. Chairman.

MR. STEIN: Thank you.

Are there any comments or questions?

(No response.)

MR. STEIN: You must have a very sympathetic State agency. They gave you three years to test that pilot plant, for studies and plant operations on your pond. I guess you must have a very good relationship.

DR. HARGRAVES: We think research pays off.

MR. BADALICH: Thank you.

MR. STEIN: Mr. Smith?

MR. SMITH: The next community on the river going downstream is Newport. I do have a written statement I would like to read which will be put in the record.

This is dated February 6, 1964.

"This letter is written by us at the request and direction of Mr. Basil Loveland, Mayor of the Village of Newport.

"This letter is intended to constitute a statement by the Village Council of the Village "of Newport pertaining to sewage treatment facilities, through us as Village Engineers.

"The Village of Newport currently has under construction a separate sanitary sewage collection system and sewage treatment plant.

"The sewage treatment plant is intended to treat all of the sanitary sewage tributary thereto plus a very nominal amount of industrial wastes. There are no major waste producing industries within the Village of Newport, currently in operation.

"The sewage treatment plant under construction is of the contact stabilization type with aerobic digestion, a modification of the activated sludge process. It is anticipated that the plant will provide a minimum of 90% removal of five day B.O.D. It is anticipated that the plant will be in operation prior to the completion of the sanitary sewage collection system. This is a requirement of the Minnesota Department of Health. It is not anticipated that there will be a discharge of raw sewage directly to the river at any time. The plant includes provisions for chlorination."

MR. STEIN: Thank you.

MR. SMITH: The next community is St. Paul Park. Is there a representative here from St. Paul Park?